5. Biodiversity Research in Malinau

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Aims

A biodiversity baseline

Effective biodiversity conservation requires not only ability to monitor biodiversity and to predict the impacts of human activities, but also an ability to influence those activities in instances where there is an adverse impact on biodiversity. Human activities are influenced by many factors, including government and international policies, and non-policy factors such as belief systems, or availability of technology. CIFOR is in a strong position to influence forest policies through channels including the Convention on Biological Diversity, the United Nation Forum on Forests, national governments, NARS and NGOs. It is also important to distinguish between the underlying causes of certain activities and the more immediate driving forces. The studies we have undertaken in Malinau provide a detailed case study that contributes to these larger global goals, as well as providing a highly relevant baseline of information for local use.

The Malinau area of East Kalimantan was, until recently, little known biologically. It was suspected that the rugged forested landscape, next to the Kayan Mentarang National Park, would have a high biological conservation value. A major emphasis of our work has been to begin to document this biological wealth. This research has had three major components: 1) finding out what occurs where, 2) assessing to whom it matters and in what way, and 3) identifying how to maintain this biota in the future. The first two elements have required extensive fieldwork in both the wider landscape and in the experimental RIL harvesting site, while the last has required an extensive review of current scientific knowledge. Together these three strands of information help define priorities that reflect local considerations and can inform a wide range of processes, from the development of reduced-impact logging guidelines to international forestry and conservation policy.

The earliest studies involved a wildlife and tree survey in the PT Inhutani II-CIFOR experimental site prior to harvesting. Ultimately this baseline allows the assessment of impacts of local interventions, such as reduced-impact techniques. The tree data are reported in Chapter 4.

Later surveys examined the wider landscape and determined local priorities. More specifically, we developed methods to identify and comprehend those aspects of the landscape that are most significant in determining its importance to local communities. Though the principal activities can still be viewed as biodiversity surveys, we did not seek species records alone. We sought means to indicate the relevance of this information and how it weighs against other considerations. Systematic queries of local attitudes to landscape and biota by a range of techniques assessed what was important and why. The wider studies have involved extensive field surveys emphasizing vegetation and site characteristics, while additional studies have investigated fish, amphibians and reptiles.

To develop a better baseline of what we already know about the animal species in Malinau and what it implies for management outcomes, CIFOR initiated a review of relevant wildlife literature (to be extended to include flora in the

future). The review covered both published and unpublished sources and involved broad consultations with national and international experts and institutions. It helped us to clarify local needs and principles in defining 'wildlife friendly' forest management, and uncovered the main knowledge gaps where further research is likely to prove valuable.

Achievements and outputs

The studies have provided baseline data on several major taxonomic groups. Lists include birds, mammals, reptiles, amphibians, fish, various invertebrates, trees, herbs, climbers, and various other plant groups. These lists are based on extensive observations and collections, as well as information from local communities. Amongst the collected taxa are a number of new species. In most cases, the species records are a part of a wider collection of information that includes geographical locations, ecological parameters, and the needs and preferences of local communities.

We have developed a suite of methods to assess biodiversity, landscape information and what matters to local communities. Our methods emphasise the importance of deciphering the sometimes-complex relations and interdependencies that can exist between local people and their environment. They are a step towards clarifying local needs and concerns, in indicating key areas for further evaluation, and in developing a mutually comprehensible dialogue amongst stakeholders.

Our approach to surveying biodiversity in the context of local people's preferences and needs has inspired similar work elsewhere. Already activities have been initiated by CIFOR in southern Africa (Mozambique), and there are plans to develop comparable studies in Bolivia and central Africa. In addition, NGOs and commercial companies have expressed interest in our methods. Our tree recording method has already been adapted by ICRAF for work in Sumatra.

Ultimately we have five classes of results:

- An account of the biophysical context in Malinau (particularly site and vegetation, but also fish and other fauna).
- How local preferences relate to the landscape in Malinau (with an emphasis on vegetation resources, but with some information on animals). This includes a baseline summary of human-cultural, demographic, and socio-economic context in seven communities.
- Emerging suggestions of how these views may be incorporated into various ongoing activities such as RIL.
- Methods demonstrating how to assess local preferences as a basis for better land use decisions.
- Identification of topics requiring further development and research.

Here we shall focus on the first two. But the third is in draft form, and the fourth, the methods, is the subject of a report to be published separately (Sheil *et al.* 2002). The fifth is a fluid backdrop to ongoing developments, and some examples are provided, especially in the review of wildlife sensitivities.

Reports and publications

See Annex in CD-ROM

Selected research summaries

Exploring biological diversity and local people's perspectives in forest landscapes—the 'MLA survey'

Overview

General

This study combined both biological and social aspects, in order to determine not only what species and habitats were present but also how local communities used and viewed them. Such knowledge helps identify the priorities and needs of local stakeholders. Surveys were undertaken in seven communities, established 200 survey plots, and collected a wide range of specimens and related information.

Our methods addressed the complex relations that can exist between local people and their environment. The survey was not intended as a fully participatory approach to doing biodiversity studies. This is, rather, a first step in increasing our

Punan women (Long Jalan) expressing the relative importance of different types of land and location in their landscape. Logged over forest is generally seen as very undesirable for these forest dependent people. Our evaluations allow steps to be taken to address this.

understanding of local priorities. As we conceived this as an explicitly multidisciplinary approach, and emphasized entire landscapes, the working name for our survey was the 'Multidisciplinary Landscape Assessment' or MLA. The methods were developed and used during surveys in Malinau, East Kalimantan between 1999 and 2000. They were developed through workshops, a series of pretrials, and a full-scale pilot study in two communities, with subsequent application in five additional communities.

We chose to work with Merap and Punan communities who represent two distinct cultures in the Malinau watershed. The Merap are a politically influential group in the local context, with strong affinities to the regionally powerful Kenyah (though the language is distinct). The Punan have been much less politically visible. The main difference between the two groups, at least until very recently, is the emphasis that the Merap place on rice farming, while the Punan have specialized in non-agricultural extractive forest-based activities. Efforts by the government have sought to settle the Punan and encourage their agricultural development.

We examine biodiversity information within a broad context where its relevance to real decisions and choices may become apparent. The work has faced obstacles: transport was difficult due to the extreme ruggedness of the area; background materials, such as maps, were limited; and many collected taxa could not be identified using available references. Our principal delay in processing and finalizing the survey data has been the effort required to determine all the plant records. Many of the results we present *should be seen as provisional* accounts of work in progress. This is especially true with the botanical data, where ongoing taxonomic review must continue to review the less-known taxa.

Overview of Methods

We devised field methods that emphasize landscape-scale characterization through high replication of small data-rich samples, and assessments of communities based on these samples. In addition, there were a series of village-based exercises. Initial meetings with a village community were undertaken jointly but for most purposes, the survey team was divided into two. The *village team* collected a wide range of qualitative and quantitative information about the judgments, needs, culture, institutions and aspirations of the local communities, and examined their perceptions of and relationship with the local landscape. The *field team* assessed site properties, including plant and soil resources, through both 'scientific' and indigenous approaches, at specific georeferenced sample points.

Each community was studied for three to four weeks, though follow-up visits occurred beyond this period (see Table 5.1). Paya Seturan had Kenyah and Merap members, and Laban Nyarit had both Punan and Merap members. In general, efforts were made to keep these separate in the data recording though this was not always practical in general activities such as community meetings.

Though we had originally proposed to develop methods that could yield valuable information in a couple of weeks we later realised the benefits of working a bit longer in each community in order to secure the necessary trust and involvement of the people. For this reason we have more in-depth data on a few communities rather than superficial data on many.

The village team, along with several local assistants, collected data through community meetings and focus group discussions, with household surveys and interviews. In addition, key informants were used to identify, locate and assess the local values of forest products and local landscape units. A series of scoring exercises, known as the Pebble Distribution Methods (PDMs), were used to quantify the importance of products and lands. These classes are also used in the plant use assessment and in scoring field sites. These classes are detailed in Table 5.2.

Two hundred research plots were established in the Malinau watershed in four separate data collection periods (between November 1999 and November 2000). Sample sites represent a wide range of local environments. While forest variation was an

emphasis, we also included a broad range of non-forest sites for comparison. We specifically sought out and included sites that may have restricted biota and are important to local people. To achieve this we developed maps together with the community, in conjunction with more conventional map materials. The distribution of the plots within each village area is shown in Figure 5.1.

Factors used in site selection included land cover, use, local topography, altitude, presence of specific soil features, and special sites (such as old villages and salt springs). The guiding principle was to cover the range of site variation in a reasonable geographical spread of points within logistical constraints. We were rarely able to sample at large distances away from the villages unless transportation allowed. For an overview, the 200 samples have been classified into eight broad categories (see Figure 5.2). These are distributed across all the village territories (Figure 5.3).

The sample plots were constructed around a 40 m long reference line marked with a strong tape. Local informants, generally one male and one female, were interviewed about the site. Then the herbs, climbers (and other non-tree non-shrub lifeforms), would be recorded, followed by the dominant seedlings, saplings, and shrubs and finally the trees. The interview team and local informants followed the botanists and cross-referenced plant-specific data by shared referencing. The soil scientist assessed and collected soil at the same locations during the same period and also linked biophysical and local informant approaches.

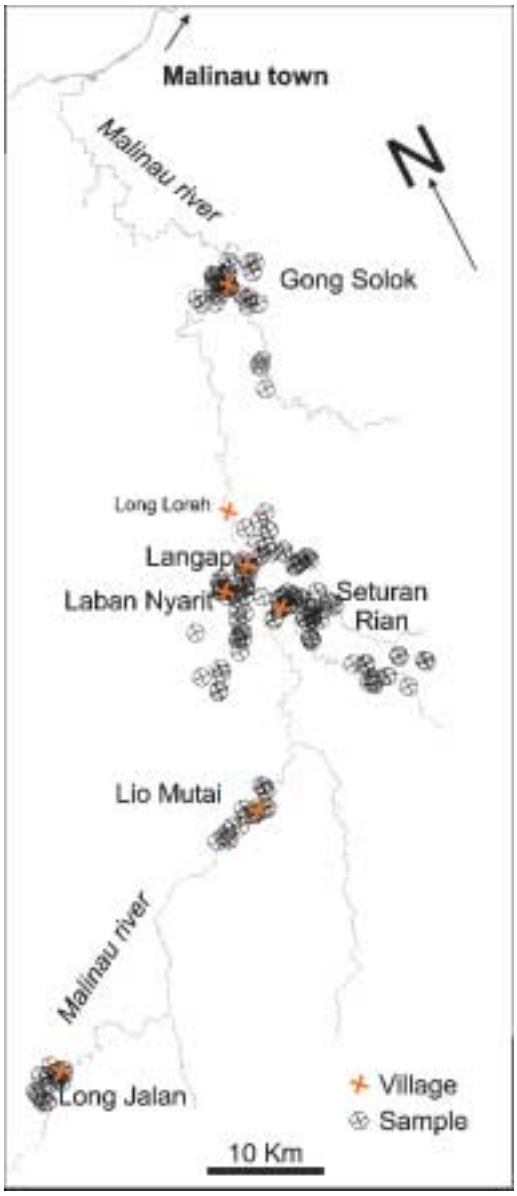
Table 5.1 Survey phases, locations and dates

Phase	Village	Principal ethnicity	Period and notes
1 (Pilot)	Paya Seturan Rian at Kuala Seturan	Merap & Kenyah Punan	September 25 to November 23, 1999 (with Rian also) with follow up (revised methods) December 2000.
2	Langap	Merap	April 23 to May 21, 2000.
	Laban Nyarit	Punan & Merap	May 22 to June 16, 2000.
3	Long Jalan	Punan	July 23 to August 24, 2000.
	Lio Mutai	Punan	August 25 to September 14, 2000.
4	Gong Solok	Merap	November 7 to November 28, 2000.

Table 5.2 Classes for uses and measures of importance

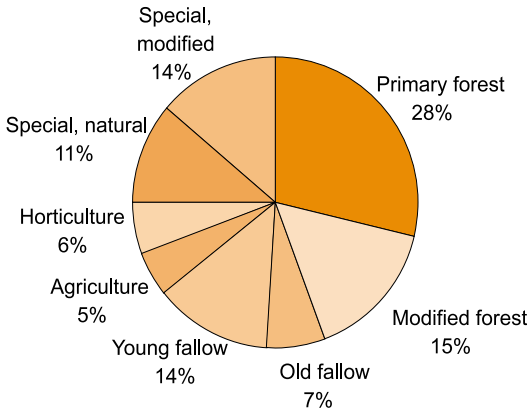
No.	Category	Explanation
1	Food	Primary and secondary foods; famine foods
2	Medicine	Medicinal and health-related
3	Light construction	Poles and cut timbers for huts, forest camp structures, fences
4	Heavy construction	Poles and cut timber for houses
5	Boat construction	Timber for boats (not including oars or punting poles)
6	Tools	Plant parts used for tools in agriculture, hunting, boating: blowpipes, spears, oars, punting poles, rice pounders, tool handles
7	Firewood	Fuel
8	Basketry/cordage	Cord made from vines, rattan canes and bark for weaving or tying
9	Ornamentation/ritual	Plant parts used in ceremony, dress, jewellery
10	Marketable items	Plant parts and processed products that are sold for cash
11	Hunting function	Poisons, bait, gums used to catch animal prey
12	Hunting place	Indirect use of plant as hunting location, usually when fruiting
13	Recreation, toys, fun	Area or forest products used for entertainment needs
14	The future	General (not explained in detail)
	Other	*What we have missed*

Figure 5.1 Distribution of survey villages and plots



Map of the Malinau river basin showing the location of the surveyed villages and field sample points. While distances look slight, this map does not portray the great difficulties of local access and terrain. For example, the survey team took three full days to reach Long Jalan by boat from Long Loreh—an apparent direct distance of 50 km, or around 100 km by river. In reality, the GPS track showed it as 135 km, the difference due to the rugged river course with rapids and numerous hazards.

Figure 5.2 Distribution of plots by eight summary site type classes



The classes are defined as follows:

PF = Primary forest – Forest that has never been greatly modified. This includes all forest that has never been logged, cut, slashed or modified by fire, wind or flooding. If the primary forest is of 'special character' (on limestone, coal, shallow soil, swamp, at a salt spring or has sago) and is restricted in extent, it is labelled as 'Special-natural'.

MF = Modified forest – Forest modified by human (includes logging) or natural causes (wind blow, floods, landslide). If the forest has been logged, cut, slashed or modified by fire, wind or flooding, it is labelled 'Modified' and be given one of the following subtypes: logging (lo), pole cutting (p), wind (w), drought (d), fire (if), flood (fl), understorey slashing (u). See also SM.

OF = Old fallow – Previously cultivated area abandoned more than 10 years ago. Old fallow is generally dense woody regrowth.

YF = Young fallow – Previously cultivated area abandoned less than 10 years ago. A subcode indicates 'years since cultivation'.

H = Horticulture – Perennial crops (often cash crops). If a garden or plantation is not at the same time an old village site, the label 'Horticulture' is given. The following subcodes are used in addition: fruit garden (f), cocoa (cc), coffee (c), old village site (ov).

A = Agriculture – Cultivated in the year of survey. Generally used for plots that were cultivated or tended at the time of sampling, with additional sub code for the type of crop: rice (r), cassava (m), beans (k), sometimes an (s) for swampy location. Plots that were just burned (less than two months ago) were avoided.

SN = Special-natural – Vegetation at special site or with special character, usually very localised, and never modified by people. If primary forest is of 'special character' (e.g. on limestone, coal, rock, swamp, at a salt spring or has sago) and is restricted in extent, it is labelled as 'Special-natural' and will be given one of the following subtypes: swamp (s), salt spring (ss), coal (co), limestone (li), shallow soil (sh), sago (sa).

SM = Special-modified – Vegetation at special site or with special character but modified in some way. As SN, but with modified character as defined above for 'Modified forest'. Also other sites of restricted and/or special character like old village sites or grave yards and bamboo stands. Includes modified forms of sites otherwise potentially 'special natural' and also old village site (ov), graves (g), and bamboo (b).

Figure 5.3 Map of sample locations by type and village location. See Figure 5.2 legend for definition of these types

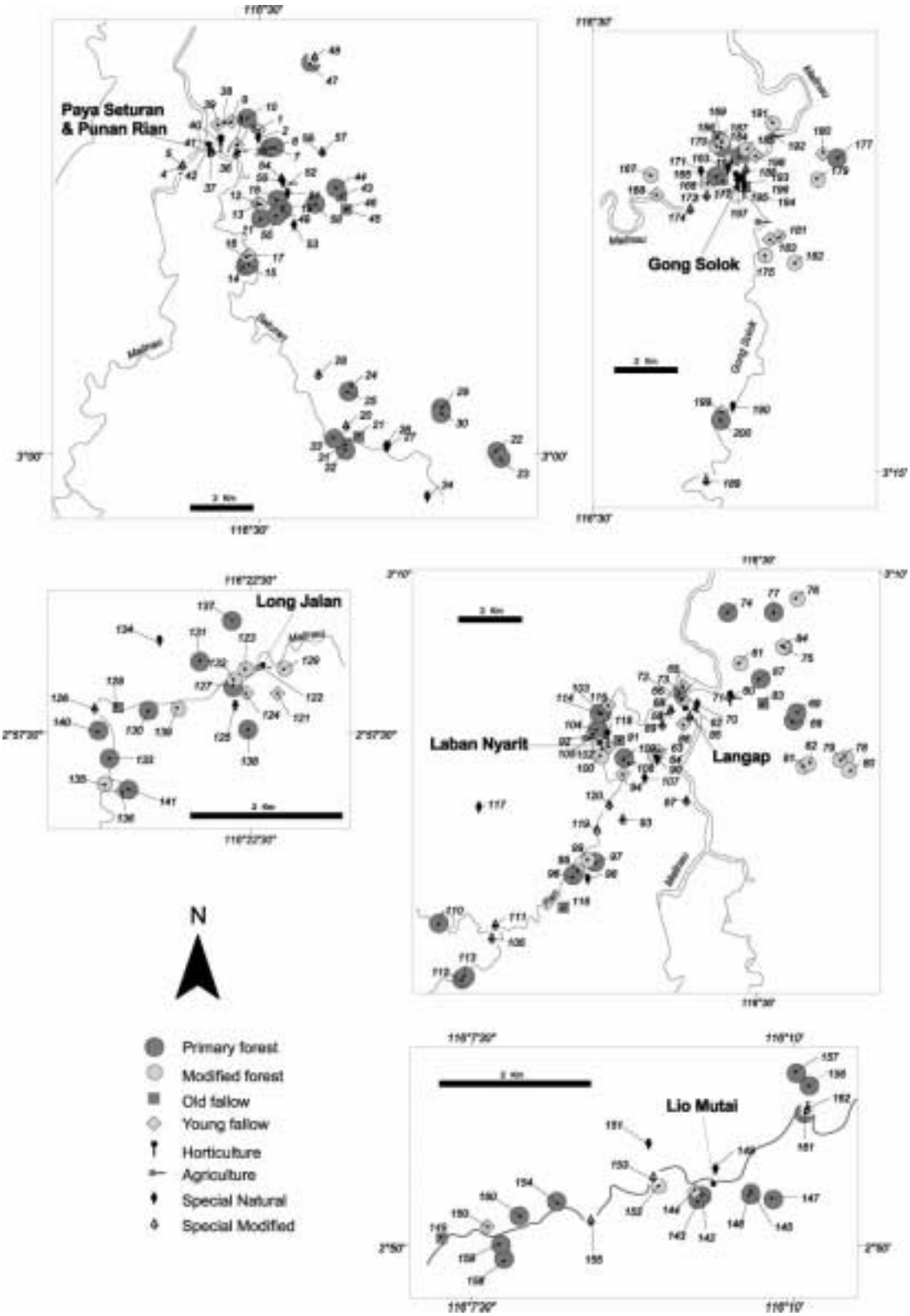
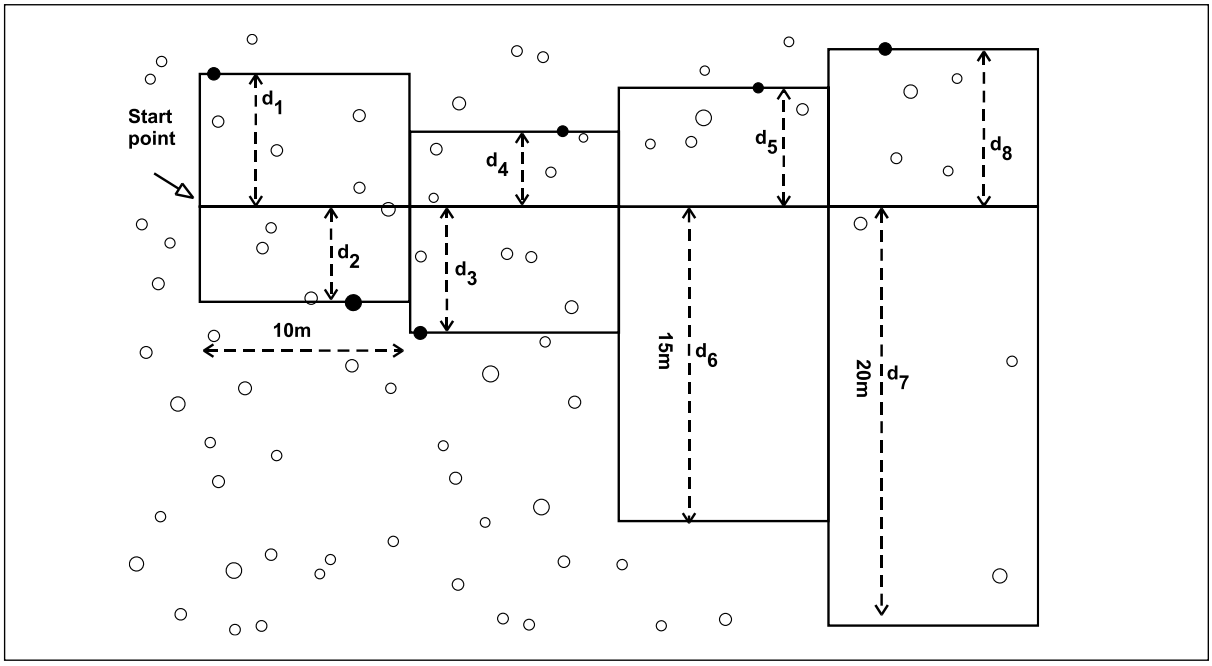


Figure 5.4 Our novel tree sample unit



This is composed of eight 'mini-transect' cells, each 10 m wide, that extend from each side of the 40 m transect line. All distances are defined horizontally. Each cell captures five trees, or fewer, and the distance to the most distant 5th tree is recorded (filled in the figure) (d_1,d_2,.. etc.). The maximum distance searched in each cell before deciding it is 'empty' is 15 m (see d_6). The maximum distance to search to collect up to five stems is 20 m (see d_7). Full details are provided in Sheil *et al.* (in press).

For trees we devised a new versatile sample unit suitable for rapid assessments of tropical forest in heterogeneous areas. The method uses multiple applications of variable area subunits, in which the area was defined by simple and objective rules (see Figure 5.4). Compared with fixed-area approaches the sample unit is quick and easy to apply even in difficult terrain, and the amount of information collected varies little with stem densities. Unlike most variable-area methods, difficult judgements are rare. Further, it cannot be extended to arbitrary size, but remains compact, allowing data to be analysed with respect to site-specific variables. We believe this efficient approach can be beneficially applied elsewhere, even in patchy and divided environments. We have published a more detailed account of this new method (Sheil *et al.* 2002).

Around 8000 voucher specimens were collected during the four survey periods. The preparation of an adequate reference list of vascular plant records of this survey took a long but necessary period of detailed herbarium work (at the *Herbarium Bogoriense*), and was only ready in draft form in July 2001.

A data coordinator ensured that all revisions led to a single best data version. We have three linked databases for plot data, village data and GIS. The plot database contains information on terrain, soil, plants, animals, site history, site importances and ethnobotany from the 200 field sites (Figure 5.5). The village database (see Table 5.3) contains diverse data on population, culture, traditional knowledge, and 'importance scores' from seven villages. Since each plot was taken in the territory of one of the seven villages and these villagers were our informants, the field data also relate to specific villages. All plot locations are geographically referenced and thus can be linked with the GIS that includes information on rivers, roads, villages and their preliminary territory boundaries, from a variety of sources including many of our GPS reference points.

Overview of Results

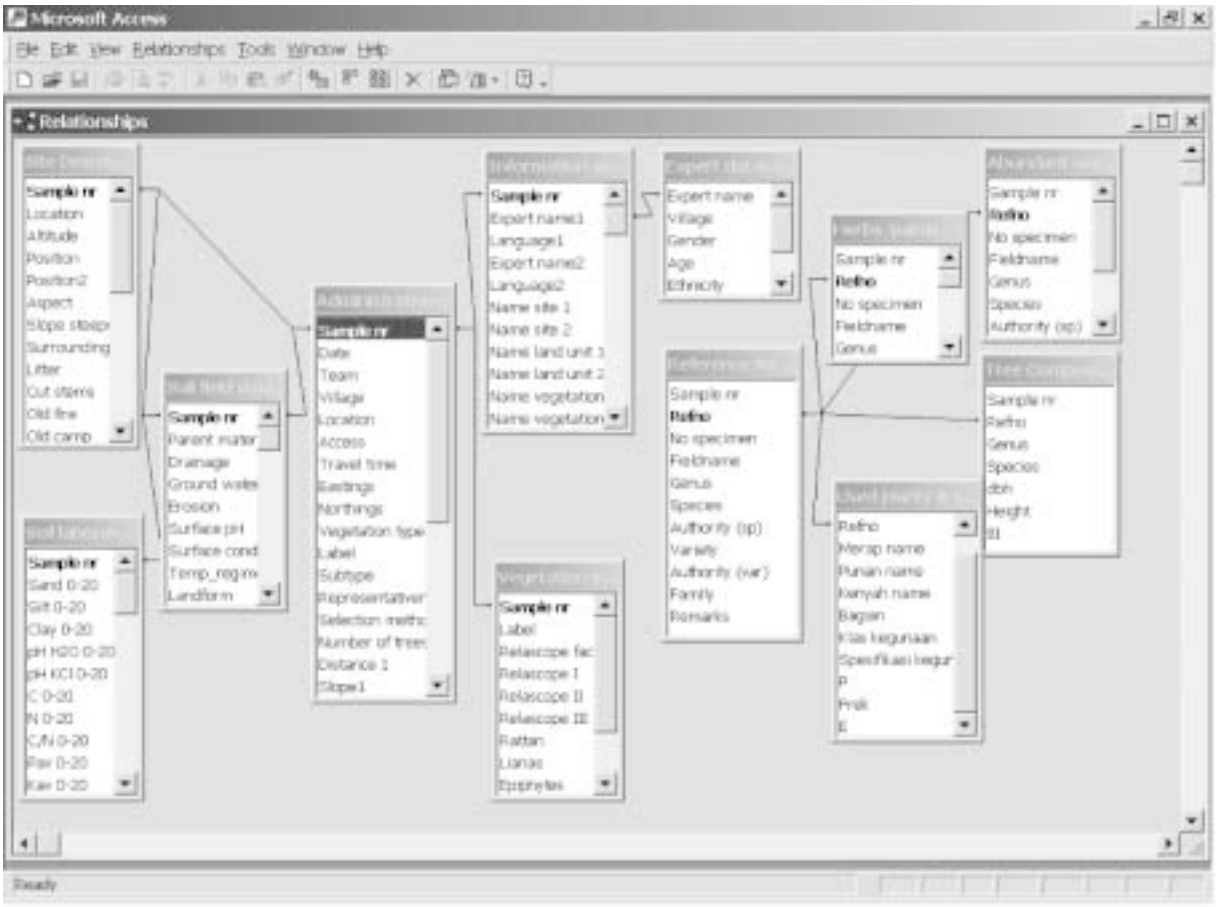
The following sections illustrate the breadth of the survey information, starting with the village data collections, followed by the field data, and some broader generalizations. For many results their significance lies in the specific details they provide. We have collected so much information that only a few illustrative examples can be presented here. Though the resulting account becomes a diverse

Table 5.3 Village Survey exercises

Title of exercise	Method
o Village description/perspective of land use	Interview with village head only
o Cultural background of land use	Interview with traditional leader only
o Settlement history and land use o Disasters and important events	Interview with village head and traditional leader
o Demography	Census and documentation from village head
o Household survey (inc. views and aspirations)	All (or at least 30 households)
o Traditional knowledge on land use o Forest product collection and sale	3–5 key informants
o Price of traded goods	3–5 shopkeepers
o Land and forest types o Forest products	Community meeting
o PDM* landscape units o PDM Past-Present-Future o PDM Distance of landscape units o PDM Sources of products o PDM Most important species per use category	Focus group discussion. Group by women/men, old/young & ethnic group

* PDM = Pebble Distribution Method

Figure 5.5 Links between the tables in the plot survey database



'scrapbook' of results, observations and comments, this should convey the multilayered and multifaceted approach of the survey. The insights and understandings that are gained simply by staying in the villages and undertaking the survey with the community are especially hard to capture in any brief summary. Many survey activities help to develop shared references between researchers and community members, and to stimulate a less formal but deeper dialogue. These may be some of the most precious results—potentially offering the explanation of various puzzles that appear during the survey. To illustrate this wealth of contextual information a few informal stories and illustrations are placed in boxes throughout the text.

Future work

All results presented here should be seen as preliminary. Future analyses will draw the various threads of the survey together to explore linkages and complementarity that can only be alluded to at present. It is also intended that many of our conclusions and the various interpretations or queries they provoke will be discussed further with the communities.

Many future activities will draw on the survey data. The scope of these goes beyond the results presented below. Species list verification is ongoing, and initial results from several aspects of the survey must be reviewed again in Malinau. Work intended includes extending the vegetation analysis to examine the links with other site characters (soils, location, history); relating the PDM patterns with biophysical determinants, and examining the extent to which the species-based PDMs can be used as a basis for assessing the importance of a plot's composition; and developing spatial analyses to identify the key spatial determinants of vegetation and local importance. Crucially we must ensure that the numerous implications of the main findings are fed into relevant processes, such as the revision of RIL guidelines and codes of practice—a vital aspect of the work that will be developed through the ITTO phase two project.

Local people and local views

Maps

The initial community meetings involved a series of mapping exercises, which developed a shared geographical frame of reference. These maps located key features, resources, and sites on a base map and provided a basis for the field sampling. Part of one such map from Laban Nyarit is shown in Figure 5.6. As an exploratory examination of this data we have developed a spatial approximation of the combined data on GIS, though the imprecision in specific resource locations must be recognised (see Figure 5.7). Combining the seven community maps fills out a much wider area than we managed to physically sample. What is striking in many of these maps is the detail presented in even distant and inaccessible areas. Ecologically these maps also highlight the highly localised nature of many resources and their association with specific types of locations, many of which we have validated with our field visits.

Settlement history and important events

Langap village claims the longest history in the area. According to documents, provided to us in Langap, they have a long history of local land use that includes the planting of rattan forest gardens around villages and caves that contain valuable (swiftlet) birds' nests. Ownership has apparently been validated by previous sultans of the Bulungan area, the Dutch colonial government, and recent district court decisions. Langap historically 'invited' various Punan groups to help protect the nest sites and offered them land to live on and cultivate in return. Some Punan communities, however (Long Jalan and Lio Mutai), seem keen to emphasise their independent historical heritage in the region.

While our general observations support the view that the Merap are principally rice farmers and the Punan forest product specialists, this glosses over the differences, both superficial and profound, observed between all communities investigated. For example in Lio Mutai, a remote Punan community, we found them keen to project an apparent lack of concern with the forest, and pride in their (few) fields of rice. Some community members wished to stress that they did not need to eat sago, or even *Parkia* seeds (it appears there is some stigma attached to being a 'forest-dependent' Punan). In Gong Solok, a Merap community only an hour by road from Malinau Town, we were also surprised. We had expected, after working with the Merap in Langap, that this community would be even more linked to farming and cash-based interests, and pay little attention to forest knowledge. In fact they showed a deep knowledge of many aspects of forest lore.

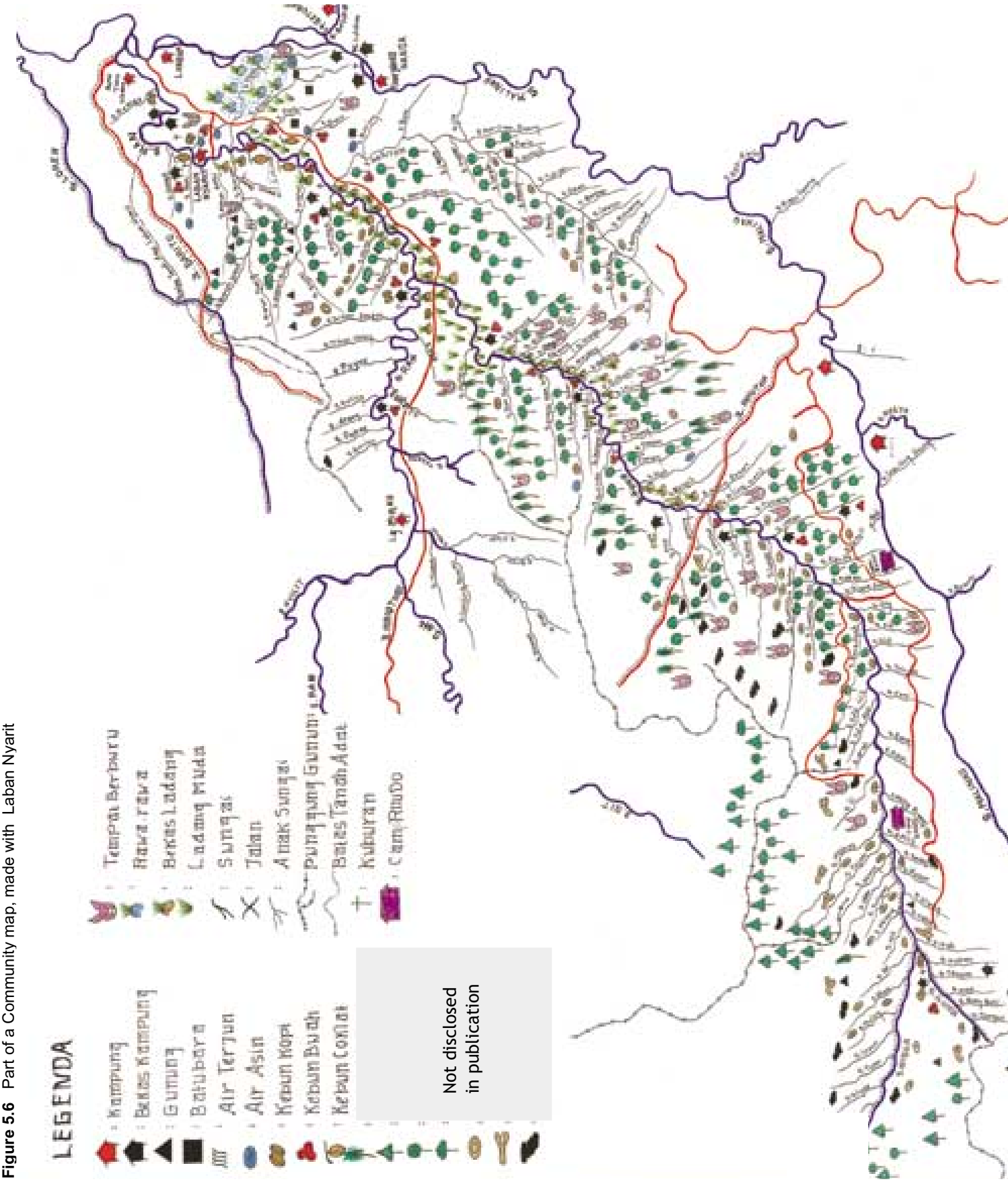
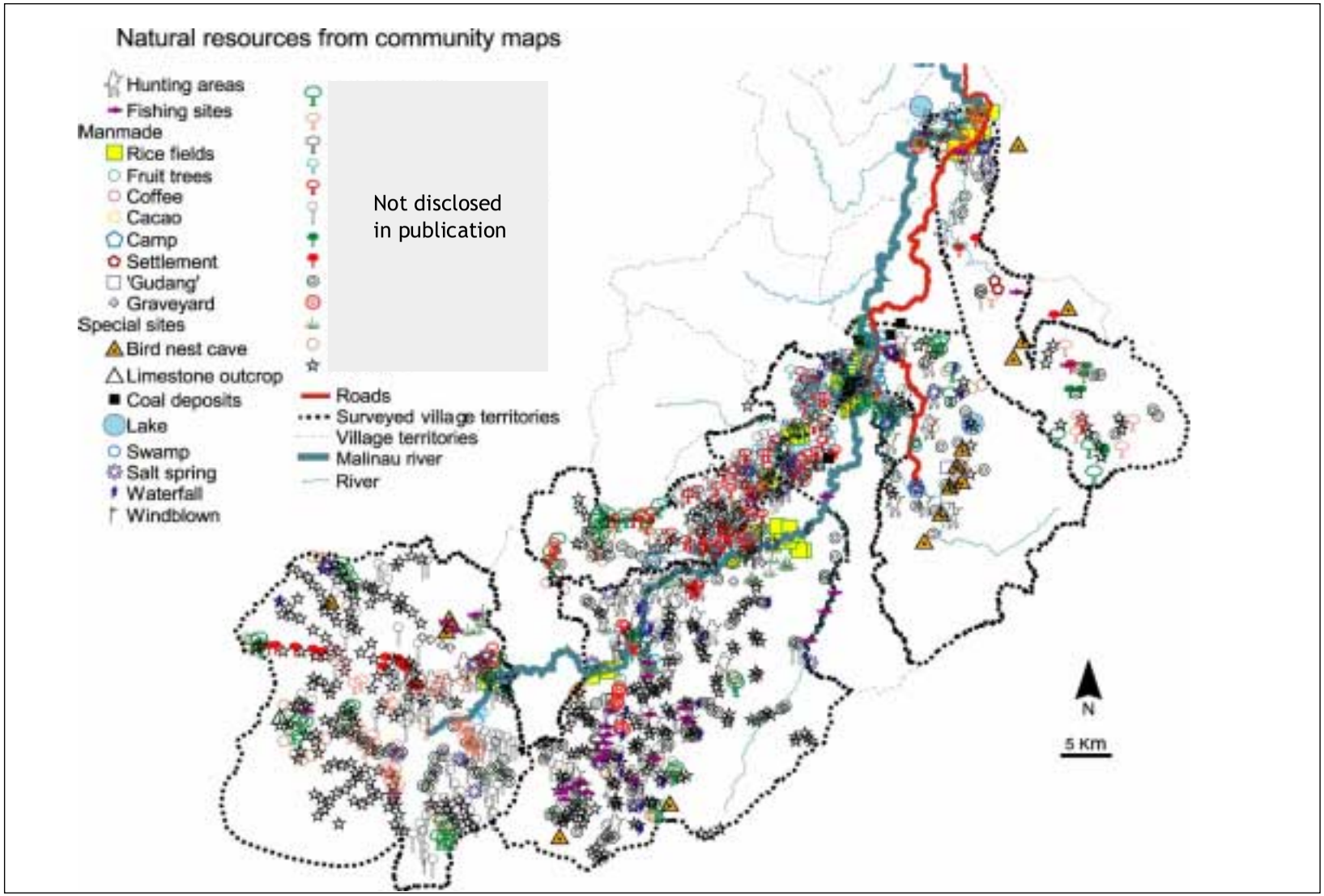


Figure 5.6 Part of a Community map, made with Laban Nyarit

Figure 5.7 A compilation of the principal data recorded in community mapping exercises with the seven communities



The map shows the territories of these villages and the specific sites and values/resources they chose to provide. This overview does not include their notes on soils, concessions, etc. The locations are approximate only.

All local communities have shifted locations several times over the past few decades. Tribal war, floods, disease, and crop failure are generally stated to have caused these movements (Table 5.4). Despite the problem of flooding, most villages are still placed on low riverside locations. More recently, the government has managed to persuade various communities to resettle from upstream locations to more downstream ones within territories of other communities. Modern-day settlements, therefore, are often far from the old village sites of communities that claim the associated territories.

Patterns of intercommunity rights are dynamic. Gong Solok village comprises two communities: a smaller Merap community and a newer larger Kenyah community that came to settle in this area, about 30 years ago. The newcomers somehow gained 'village status'. Land ownership is now in flux. There have been a various agreements, but in some areas rights are interwoven, so for example trees may belong to the Merap community, while the agriculture beneath belongs to the more recent Kenyah. This has caused us some confusion in selecting field sample sites and seeking 'values' that are restricted by such rights.

Interviews and discussions with village leaders yielded histories like those in Table 5.4.

Apart from underlining the type of threats and catastrophes that the communities have learnt to contend with, these disasters illustrate how community identity and territory is fluid. Lio Mutai is a good example. It is a small community that moved recently, having lost their previous settlement, Long Keramu, due to the flood of February 1999. They are a part of the former Long Pelancau community which has split several times. We identified at least four former village locations (Pelancau itself, Ngkah Limpah, Menoreh and Bengawat) which are now partly within the territories of other communities (Long Metut and Tanjung Nanga). Now that territories are claimed for possible compensation from timber and coal companies, these histories pose a complex and politicised basis for assessing rights. This issue has provoked conflict in some areas. For example, Langap Merap claim that according to *'adat'* they should be receiving the compensation that many 'newcomer tenant' communities are receiving in their place (see Chapter 7).

Table 5.4 Summary of village movement history, Langap Village

Name of settlement	Location	Year of leaving	Reason for leaving	Use now
Siram Nyam	*S*. Bahau, S. Kayan*	-	War with the 'Suku Kayan'	Forest (since long ago)
Batu Lalau	*Upstream Sungai Malinau*	-	War	Forest (since long ago)
Gn Nyurat	*S. Kelawit*	-	War	Forest (since long ago)
Long Pelancau	*S. Malinau*	-	War	Forest (since long ago)
Long Lemirang	*S. Malinau*	-	War	-
Long Kelawit	*S. Malinau*	-	War	-
Lio Laban	*S. Malinau*	-	The settlement burnt	Fruit
Lio Tanam	*S. Malinau*	-	War	Fruit
Lou Kenowa	*S. Malinau*	-	War	Fruit
Long Ran	*S. Ran*	Long time ago	War	Fruit
Lou Ngetow	*S. Betung*	Long time ago	War	Fruit
Kuala Kitan	*Kuala Kitan*	c. 1940	War	Fruit
Kuala Sidi	*S. Sidi*	c. 1950	War	Fruit
Langap-I	*S. Idatu*	1963	Floods	Fruit
Langap-II	*S. Idatu*	1993	Floods	Fruit
Langap-III	*S. Idatu*	Now (2000)		Village

*S = Sungai (River)

Table 5.5 Summary of village movement history, Long Jalan Village

Name of settlement	Location	Year of leaving	Reason for leaving	Use now
Long Lake	*Kuala Lake*	1940	Needed somewhere nearer the town	Fruit
Long Jalan	*Kuala Jalan*	1963	(unknown)	Fruit
Lerong Kirip	*Lembo Kirip*	1973	Many died from epidemic	Fruit
Sungai Arah	*Sungai Arah*	1980	The village head wished to move	Fruit
Engkah Bulu	*Sungai Malinau*	c. 1980	Seeking a more level place to stay	Fruit
Long Jalan	*Sungai Malinau*	Now (2000)	-	Village

Table 5.6 Disasters and important events, Langap Village

Year	Disasters and important events
1940	Cholera epidemic; many people died.
1963	Mr. Impang Alang brought cocoa seeds from Malaysia to be distributed and planted in Langap and Malinau.
1969/70	'Banjir kap' resulted in massive riverside timber cutting. (Original entry here 'overwhelmed by logs')
	1969/70 The Kenyah Pua asked for permission to live upstream of Langap, at current location of Tanjung Nanga Village.
1970/71	The Kenyah Lepo' Kuda asked for permission to live downstream of Langap, at the current location of Long Loreh Village.
1975	The customary heads of Malinau (Mr. Alang Impang and Mr. Impan Alang) received rice seeds from President of Indonesia, Soeharto.
1975	Ethnic Punan of Nunuk Tanah Kibang village moved from Tubu River to the Langap area.
1980	Boat engines and chainsaws procured by community members.
1982/83	Forest fire; agriculture fields started to move to the west side.
1986/87	The Punan inhabitants of Metut and Long Lake moved to Seturan Village. At the same time the INHUTANI II logging concession was being established in that area.
1993	The settlement moved to another place since the old village was flooded.
1998	Big flood.
1994	Malaria.
1999	Big flood at Keramu Village.

Table 5.7 Disasters and important events, Lio Mutai Village

Year	Disasters and important events
1945	Dangerous (unknown) disease
1969	Dangerous (unknown) disease
1982	Flood at Mengawat Village
1983	House fire at Mengawat Village after long dry season
1986	Big flood
1979	Tuberculosis spread at Mengawat Village

Land and forest types

Communities have a rich terminology to describe the landscape. Examples of this are illustrated in Table 5.8.

Forest products

People were asked to list the main products they use from the forest, examples of which are shown in Table 5.9.

PDM results

The Pebble Distribution Method exercises were used to score the perceived importance of various land and forest types. Here we present only a few examples.

Table 5.8 Punan names for land and forest types in Long Jalan and Lio Mutai*

Land and forest type *(Bahasa Indonesia)/Punan name*	Site example (Name of place and river)	
	Long Jalan	**Lio Mutai**
Village (Kampung)/ *Tukung*	S. Malinau	Lio Mutai, Long Metut
Old Village (Bekas kampung)/ *Lepuun*	S. Jalan	Keramu, Plancau, Long Menoreh, Engkah Limpak, S. Kurak, S. Cop S. Buka, Bengawat
Cemetery (Kuburan)/ *Tanam*	Lirung Kirip (S.Malinau)	S. Tengkawang, S. Legutung, S. Bekukuk, S. Tanung
Mountain (Gunung)/ *Bota'*	Engkah Bulu (S. Mabi), Bulu' Ran (S. Ketaman)	Tenayung, Abuh, Batu Aron, Loung, Anyen
Swamps (Rawa-rawa)/*Pangkah*	Puten (S. Puten)	Sungai Metut
Agricultural field (Ladang)/*Umoh*	S. Puten, S. Malinau, S. Mabi	S. Metut, S. Uli, S. Malinau
1 year fallow (Bekas ladang tahun lalu)/*Bai/Balah uyung*	Klikut (S. Malinau), Bota Nuying Bulu'	S. Metut, S. Keramu, S. Uli
<5 yrs fallow (Jekau < 5 Th)/ *Balah bai*	S. Bukaha, S. Cop.	S. Lemiling
5–10 yrs fallow (Jekau 5–10 Th)/ *Balah tokan*	S. Loopiyan	S. Lemiling
11–20 yrs fallow (Jekau 11–20 Th)/ *Balah tuan*	S. Ran	S. Mengawat, S. Plencau, Engkah Limpak, Mekayan, S. Buka
Hunting places (Tempat berburu)/ *Deh Mengan*	Available at almost all sites surrounding the village.	S. Metut, S. Keramu, S. Mekawat, S. Piyang, S. Buka
Fruit trees (Kebun buah)/ *Lida bua*	S. Lake, S. Arah, S. Jalan	Engkah Limpak, Loa' mati, Plencau, Kuala Mekayan, Kuala Menoreh
Banana plantation (Kebun pisang)/ *Lida puti'*	-	S. Pasang
Water fall (Air terjun)/ *Oung*	S. Engken, S. Batu	S. Cop, S. Bukaha
Customary forest (Hutan adat)/ *Tano' tuan*	S. Liu, S. Liu Ngalidan, S. Belung, S. Lelum, S. Liu Opu, S. Liu Nou, S. Batu Kuceh, S. Bengaeh, S. Kelayan, T. Nyurat, T. Penaluk Bela	Peta' Pui up to S. Lirip along S. Malinau
Sago forest (Hutan sagu)/ *Tuan vulung*	Bota' Cerebeh (S. Lemusan)	
Koompassia forest (Hutan benggris)/ *Tuan tanyit*	S. Malinau, S. Arah	
Agathis forest (Hutan Agathis)/ *Tuan tumuk*	S. Emgken	
Dipterocarp forest (Hutan tengkawang)/*Tuan avang*	S. Patok, S. Arah, S. Lalau, S. Aci	
Virgin forest (Hutan rimba)/ *Tuan tengen*	S. Bukaha, S. Selawak, S. Puten, S. Kipah, S. Kelapang, S. Pluye, S. Piyang, Tabau Ayo.	S. Cop, Peta' Pui, S. Lemiling, S. Pasang, S. Larip
Salt spring (Air asin)/*Pan*	S. Legun, S. Pebengan, S. Arah, S.Arah Ule, S. Man, S. Liu, S. Nyihung.	Lemiling Ayo', S. Buin, S. Nyom
Bird nest cave (Goa sarang burung)/ *Laa tepilih*	S. Piang, S. Mabat, Sm Kirab	
Hill (Bukit)/ *Tiang*	Hill area	Hill area

* During the field survey we used the local stratifications of the respective villages to plan where to sample.

Table 5.9 Some forest products reported by Long Jalan and Lio Mutai villages

Forest product (Bahasa *Indonesia)/Punan name**)	Product collection/harvesting sites	
	Long Jalan	**Lio Mutai**
Sago (Sagu)/*Vulung* (principally *Eugissonia*)	Sungai (S). Piang, S. Nou, S. Kuli, SPatok, S. Tuan, Tuku' Balau, Tuku' Kaleh.	S. Tengkawang ; S. Legutung; S. Lemiling; S. An
Aquilaria beccariana (Gaharu)/*Lelah*	S. Arah Ule, S. Batu, S. Lungi, S. Liu, S. Patok	S. Kelawit; S. Metut; S. Piang; S. Balau; S. Mekayan; S. Menoreh
Agathis borneensis (Damar)/*Tumuk*	S. Liu Nou, S. Liu Ngalidang, S. S.Liu Uvo, S. Lelung, S. Belung, Upstream S. Batu, mountain top Tuku' Tangeh	S. Kelawit; S. Metut; S. Mekayan; S. Menoreh; S. Piang
Rattan (Rotan)/*We' mla, We' sega, We' tima, We' mule, We' senule* (species to be clarified)	S. Patok, S. Peliran, S.Mekuhut, S. Jeluyang, S. Kao, S. Tekalit, S. Ule, S. Niat, S. Liu	S. Kelawit; S. Metut; S. Mekayan; S. Piang; S. Lemirang; S. Balau; S. Pan; S. Abang; A. Plancau
Koompassia excelsa (Benggris)/*Tanyut*	Mouth of S. Jemak	S. Cop; S.Mutai; S. Metut; S. Kuba S. Keramu; S. Lemiling; S. Bekulu; S. Lubung; S. Ngkah Limpak; S.Mati
Palaquium gutta (Ketipai)/*Ketipai*	S. Betuen, S. Batu	S. Cop; S. Mutai; S. Metut; S. Remit S.Keramu; S.Lemiling Cop; S.Bekulu; S. Tengkawang; S. Buin; S. Pacang
Shorea parvifolia (Meranti)/*Loop*	Upstream S. Inggin, S. Liu and tributaries, S. Jalan, S. Patok.	S. Kelawit; S. Besi; S. Pla; S. Betung; S. Molang; S. Pan; S. Leruk; S. Leruk Kayo
Eusideroxylon zwageri (Kayu ulin)/ *Kacik*	S. Piang	S. Lemiling Lirung; S. Cibun; S. Legutung; S. An; S. Ulen; S.Kejala
Dipterocarps (Tengkawang)/ *Avang*	S. Lalau, S. Bulu, S. Arah	
Bamboo (Bambu)/*Bulu'*	S. Jaa, S. Piang, S. Bulu	S. Cop; S. Mutai; S. Metut; S. Keramu; S. Lubung; S. Mekayan; S. Tengkawang; S. Plancau
Bird nests (Sarang burung)/*Lao Tepilih*	S. Kirap, S. Mabat, S. Lelien, S. Puong.	S. Bau Tele; S. Kerenga'

*Several of the local names still need to be matched with scientific names.

It must be emphasized, to avoid misunderstanding, that these scores are based on a conceptual rating of 'overall relative importance'. This is a person-centred statement of preference rather than a 'value' expressed in terms of any standard economic unit. For a full background, see the survey methods account (Sheil *et al.* 2002)

Land and forest types

How do people value the different land and forest types surrounding them? Forest (*hutan,* a broad term) was considered the most valuable land in six of the seven villages. More specifically, unlogged forest is the most important type, with mountain and swamp forest ranked next.

Table 5.11 summarises the importance score of land and forest types per importance category, as a mean of all groups in all villages. This presentation makes clear that for all categories, and especially for those requiring timber, people value the (unlogged) forest highest. Rivers are preferred for recreation and secondary forests for firewood, but the unlogged primary forest (*hutan rimba,* a term specifically referring to primary natural forest) is without question the most important overall.

Table 5.10 PDM exercise summary for 'all importances' by land types for all seven communities (each result is the mean of four groups, young and old, women and men)

Village*	PS	R	Lg	LN	LJ	LM	GS	Mean	Mean
Ethnicity**	m	p	m	p	p	p	m	p	m
Village	8.5	14	12.25	11.25	19	12	12	14.06	10.92
Old village site	3.75	7.5	5.75	5.75	7.25	5.75	5.25	6.56	4.92
Garden	12.75	10	9	9.75	8.5	15	15	10.81	12.25
River	16.5	**17**	9	12	14.75	12.5	12	14.06	12.50
Marsh/swamp	12.25	7	9.25	9	6.5	3	4.75	6.38	8.75
Cultivation	15.25	14	12.25	11.5	8.5	15.5	17.75	12.38	15.08
Young fallow	5	8.5	6.25	7.25	5.75	6.5	7	7.00	6.08
Old fallow	6.75	6	10.75	11.5	6.5	7.5	6.75	7.88	8.08
Forest	**19.25**	16	**25.5**	**22**	**23.25**	**22.25**	**19.5**	**20.88**	**21.42**
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Unlogged forest	24.25	**34**	**34.75**	**24**	29.75	**43.25**	**30**	**32.75**	**29.67**
Logged forest	12.5	13.5	9.25	10.5	4	7.25	14	8.81	11.92
Secondary	22	15.5	14.75	20	16	9.25	13.25	15.19	16.67
Swamp forest	**30.5**	14.5	21.5	22.5	18.25	7	17.75	15.56	23.25
Mountain forest	10.75	22.5	19.75	23	**32**	33.25	25	27.69	18.50
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

* PS = Paya Seturan, R = Rian, Lg = Langap, LN = Laban Nyarit, LJ = Long Jalan, LM = Lio Mutai, GS = Gong Solok.
** *p*=Punan, *m*=Merap

Having observed that the food importance of forests ranks high, we examine this in further detail in Table 5.12a, per village as well as per ethnic group. Both Punan and Merap communities rank unlogged forest as the most important source of food. At the village level there is some differentiation, with Gong Solok valuing rivers as the primary food source and cultivation ranking the highest in Paya Seturan and Rian. Results are not necessarily intuitive; for example, Langap people, with their apparently more sophisticated modes of cultivation, still rated the forest more important than cultivation.

An example of a more specific PDM result can be seen in the table 5.12b, which illustrates the distribution of counters by our informant group of older women in Long Jalan, per land/forest type, per importance category. Forest again scored highest in all but the firewood and recreation category. One striking aspect of these individual exercises is the large number of zero results that often occur. This implies a clear segregation of the use-classes assessed by the land types listed. However, when results are averaged these zeros disappear, indicating that such 'zeros' are specific, not general.

Importance over time

Another PDM exercise compared the past, present and future importance of forest, and the relative importance of each category of use. A large variation was found amongst respondents, but the mean results (Table 5.13) show an increasing dependence on the forest for timber, saleable items and recreation and a decreasing importance for medicinal use, firewood and light construction. Interestingly, the past value of the forest was lower than its perceived future value. This is explained by informants as due to their previously having 'taken the forest for granted' despite their dependence on it.

Table 5.11 PDM exercise summary; means per land type, by use-classes for all seven communities.

	ALL	Food	Medicine	Light construction	Heavy construction	Boat construction	Tools	Firewood	Basketry/cordage	Ornamentation/ritual	Marketable items	Hunting function	Hunting place	Recreation	Future
Village	12.71	10.18	15.5	1.43	2.32	2.32	1.82	1.61	2.68	13.21	9.21	7.04	0.11	17.75	13.04
Old village site	5.86	6.5	4.82	4.79	1.5	1.5	2.46	2.21	4.46	5.29	6.71	5	6.04	2.11	4.89
Garden	11.43	13.86	8.39	4.71	1.07	1.07	0.25	8.61	2.5	10.46	16.86	4.5	6.96	11.71	15.86
River	13.39	15.46	11.11	10.96	6.71	6.71	8.93	19.04	10.68	15.61	14.57	7.89	14.54	**26.57**	8.54
Marsh/swamp	7.39	6.79	5.71	9.21	9.21	9.21	10.57	3.89	7.93	3.79	4.36	5.57	7.25	1.5	7.21
Cultivation	13.54	14.36	4.71	1.82	1.79	1.79	0.39	17	1.14	0.79	12.32	0.68	7.54	12.39	10.36
Young fallow	6.61	6.43	5.75	1.71	1.25	1.25	2.04	9.96	3.46	3.29	3.64	1.5	5.11	0.29	8.04
Old fallow	7.96	5.5	8.39	27.04	4.93	4.93	12.14	13.79	17.5	14.29	2.54	14.46	14.93	3.18	10.54
Forest	**21.11**	**20.93**	**35.61**	**38.32**	**71.21**	**71.21**	**61.39**	**23.89**	**49.64**	**33.29**	**29.79**	**53.36**	**37.54**	24.5	**21.54**
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Unlogged forest	**31.43**	**38.75**	**36.29**	**35.61**	**50.71**	**50.71**	**44.68**	29.07	**39.04**	**30.32**	35.79	**43.5**	**36.46**	**34.26**	**30.68**
Logged forest	10.14	8.75	8.18	8.61	5.89	5.89	5.11	15.89	5.86	9.96	8.43	4.93	7.25	8.41	12.71
Secondary forest	15.82	11.18	15.07	23.04	3.96	3.96	4.75	**35.57**	15.64	26.82	7.07	9.14	11.75	15.34	23.61
Swamp forest	18.86	11.32	12.71	12.11	10	10	14.57	10.14	14.68	12.14	12.36	13.71	15.57	18.19	13.68
Mountain forest	23.75	30	27.75	20.64	29.43	29.43	30.89	9.32	24.79	20.75	**36.36**	28.71	28.96	23.81	19.32
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

Table 5.12a PDM exercise summary for 'food importances' by land type for all seven communities (each result is the mean of young and old women and men)

Village* ***Ethnic***	***PS*** ***m***	***R*** ***p***	***Lg*** ***m***	***LN*** ***p***	***LJ*** ***p***	***LM*** ***p***	***GS*** ***m***	**Mean** ***p***	**Mean** ***m***	**Mean** ***all***
Village	10.25	**14.5**	9.25	8.75	10.25	10.25	8	10.94	9.17	10.18
Old village site	3.75	8	9.5	7.5	6	7	3.75	7.13	5.67	6.5
Garden	10.75	12	14	12	13.75	17.75	16.75	13.88	13.83	13.86
River	18.25	12	11.75	13.25	16.5	16.25	**20.25**	14.50	16.75	15.46
Marsh/swamp	10.5	12	8	7.25	3.5	1.5	4.75	6.06	7.75	6.79
Cultivation	**19.75**	**14.5**	11.25	15.75	9.5	10.5	19.25	12.56	16.75	14.36
Young fallow	3.5	8.5	8.25	7.5	5.25	4.75	7.25	6.50	6.33	6.43
Old fallow	3.75	6.5	7.5	5.75	6	4.5	4.5	5.69	5.25	5.5
Forest	19.5	12	**20.5**	**22.25**	**29.25**	**27.5**	15.5	**22.75**	**18.50**	**20.93**
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Unlogged forest	**37**	**50**	**39.5**	29.5	**35.75**	**45.5**	**34**	**40.19**	**36.83**	**38.75**
Logged forest	16.25	0	8.25	9.5	8	4.25	15	5.44	13.17	8.75
Secondary forest	18.5	0	12.75	13.25	9.25	14	10.5	9.13	13.92	11.18
Swamp forest	13	0	15	14.25	16.5	3.5	17	8.56	15.00	11.32
Mountain forest	15.25	**50**	24.5	**33.5**	30.5	32.75	23.5	36.69	21.08	30
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

*Villages PS = Paya Seturan, R = Rian, Lg = Langap, LN = Laban Nyarit, LJ = Long Jalan, LM = Lio Mutai, GS = Gong Solok

Table 5.12b Example PDM of importance of different landscape units by older women in Long Jalan

	Village	Old v illage site	Garden	River/lake	Swamp	Cultivation	Young fallow	Old fallow	Forest
ALL	20	7	13	5	10	9	9	5	**22**
Food	9	7	10	9	7	9	9	9	**31**
Medicines	46	-	-	-	-	-	-	-	**54**
Light construction	-	-	-	-	-	-	-	45	**55**
Heavy construction	-	-	-	-	-	-	-	-	**100**
Boats	-	-	-	-	-	-	-	-	**100**
Tools	17	-	-	-	-	-	-	20	**63**
Firewood	-	-	-	**31**	-	28	-	20	21
Basketry/cordage	-	-	-	-	-	-	39	-	**61**
Ornamentation/ritual	-	-	-	46	-	-	-	-	**54**
Marketable items	18	-	19	11	-	20	-	-	**32**
Hunting function	40	-	-	-	-	-	-	-	**60**
Hunting place	-	-	-	39	-	-	-	-	**61**
Recreation	**37**	-	-	29	-	34	-	-	-
Future	22	-	8	12	9	9	-	11	**29**

Table 5.13 PDM for past, present and future importance of forest (*hutan*). Mean of all seven community responses

	30 years ago	Now	In 20 years
ALL	**31.25**	**31.96**	**36.79**
Food	12.07	11.93	10.21
Medicine	*8.46*	*8.11*	*4.71*
Light construction	*10.14*	*7.75*	*5.39*
Heavy construction	**7.68**	**8.39**	**14.21**
Boat construction	**5.46**	**7.04**	**7.46**
Tools	5.43	5.36	6.96
Firewood	*7.54*	*7.18*	*5.21*
Basketry/cordage	7.46	6.43	6.64
Ornamentation/ritual	5.07	6.64	4.68
Marketable items	**6.71**	**8.11**	**8.68**
Hunting function	6.64	6.61	5.39
Hunting place	8.43	7.68	6.36
Recreation	**2.79**	**3.07**	**5.07**
Future	**6.11**	**5.71**	**9**
Total	*100*	*100*	*100*

The exercise shown involved four stages: distributing the 100 counters between the past, present and future categories in general (here presented by the row 'All'), the next three being the relative assessment of the use-classes per time period (each vertical column). Care is needed as column totals (without 'All' included) sum to 100—meaning that row trends cannot necessarily be interpreted independently of the counters placed elsewhere in each PDM—but are relative to these other classes (this can be corrected by weighting the per-column data by the overall 'All value' weight but actually, here this has little overall effect).

A more specific example of changes in valuation over time among older women in Long Jalan uncovers some interesting information (Table 5.14). This points to the rise in importance of boat building, heavy construction, recreation and the future, and a decline in medicinal use, which they believe will continue.

Table 5.14 PDM for past, present and future importance of forest (*hutan*). Example scores from older women of Long Jalan (Punan)

	30 years ago	Now	In 20 years
All value	36	34	30
Food	**13**	**10**	**5**
Medicine	11	5	-
Light construction	15	4	5
Heavy construction	-	11	13
Boat construction	-	8	9
Tools	-	5	6
Firewood	**12**	**9**	**5**
Basketry/cordage	**10**	**8**	**13**
Ornamentation/ritual	**14**	**9**	**6**
Marketable items	8	9	8
Hunting function	**8**	**6**	**10**
Hunting place	**9**	**4**	**10**
Recreation	-	4	6
Future	-	8	4
Total	*100*	*100*	*100*

Importance and origin of plants and animals

We also conducted a series of PDM exercises in each community to find out how people rated wild plant and animal resources compared to farmed or bought alternatives. Table 5.15 presents the results of the Langap Merap with those of the Long Jalan Punan.

Both communities rate total plants as being slightly more important than animals, but for *wild* sources only this pattern is reversed. Not surprisingly, remote Long Jalan places more importance on wild forest products than Langap, and the reverse is true for cultivated plants and farmed animals. The Punan in Long Jalan are relatively dependent on buying rice and crops from traders (using revenue based on the sale of forest products). They find it relatively easy to gain free animal protein by hunting and fishing. All communities, even the most sophisticated cultivators, recognise a considerable dependency on wild plant and animal resources. Breaking down these results (Figure 5.8) reveals that higher preference is given to wild animals by young men, even in the cultivation-oriented communities like Langap. Such clear and intuitive results lend credibility to examining other patterns that appear less self-explanatory.

Importance of species

The most complex series of PDM exercises were those in which informants would first score the 12 importance categories and then rank the top ten 'most important' species (plants and animals respectively) for each category . These exercises were conducted using local names, which were later matched with scientific names through various processes (though this is not yet finished).

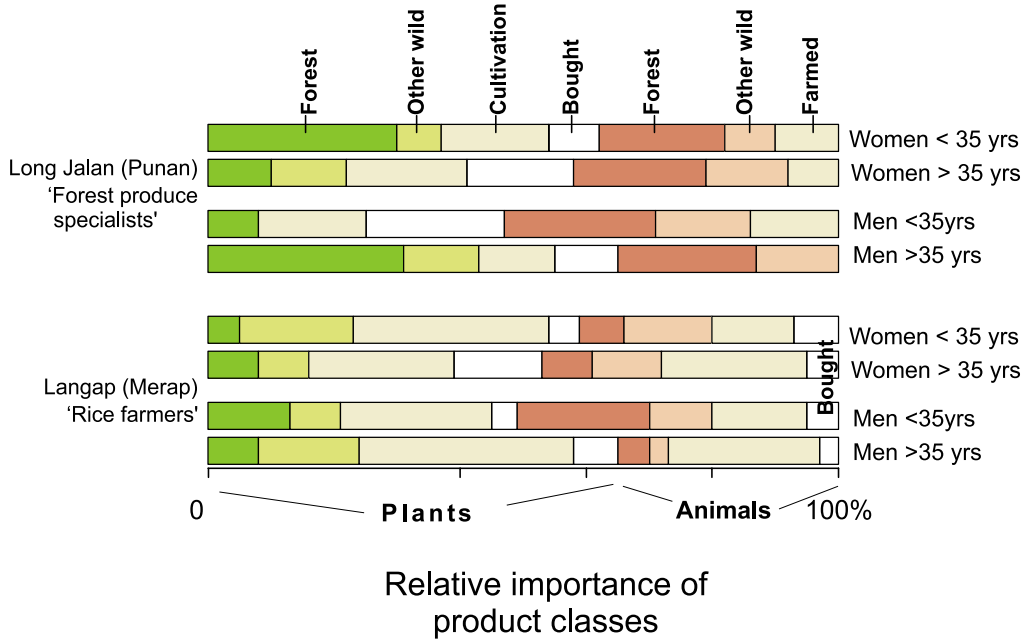
Tables 5.16 and 5.17 present examples for very small parts of these extensive exercises. The illustrations show 'medicinal' (older men in Gong Solok) and 'ornamental and ritual' importance for plants and animals (older women in Gong Solok).

In the plant section of the first table, a 'remainder' of 100% is given. This implies that there are unlisted species, which together have similar total importance to the ten listed. The second table indicates that species that are already of conservation significance have traditional values, e.g. hornbills and bears. A further, more general result is to acknowledge that species outside normal 'subsistence requirements', such as food, shelter and medicine, can be given high levels of importance. High importance is found in all classes, though the ritual use has special significance. This arises because in many uses such as food there are numerous alternative species, while with ritual uses there are not.

General facts

The six survey questionnaires are not easily generalized or summarized. They provide an introduction to, and a general overview of, the respective villages, including land use, livelihood, traditions and environmental issues. A few general

Figure 5.8 Graphical presentation of a PDM importance-scoring exercise in which the residents of Long Jalan and Langap compared the relative importance of various origins of animal and plant products



In Long Jalan, men focus on gaharu collection and collect much wild meat but have little time or suitable land to cultivate and rice is bought, while in Langap the farmers are more self-reliant and grow much of their food, and have time to rear animals other than chickens. Even in Langap, however, young men like to hunt wild animals.

Table 5.15 Mean PDM scores for importance of different sources of plants and animals in Langap (22 Merap informants) and Long Jalan (25 Punan informants)

Products/ Village	Wild forest plants	Other wild plants	Cultivated	Bought plant products	Wild forest animals	Other wild animals	Farmed animals	Bought animal products
Langap	8.5	12.5	**28**	7.5	10.25	9.5	**18.75**	5
Long Jalan	**19.75**	7.75	16.25	14.25	**21.75**	12.25	8	0

Each result is the mean of four groups (men, women, young and old).

facts have been distilled and can be complemented with insights and verifications from the field teams. Part of each village survey was a basic census, which allowed a summary of village populations, sex, age, ethnicity, occupation, religion and capital items (such as boat engines and generators). Some of these are summarized in Tables 5.18–5.20.

Health, education, economy, religion and adat (traditional rules)

Health facilities are limited. For the treatment of any serious illness, people in the middle and upstream ranges of the Malinau River need to travel considerable distances. Communities place significant importance on traditional medicines.

Table 5.16 Example portion of PDM based on species by importance. This shows the medicinal importance for plants and animals given by older men in Gong Solok (Merap)

Plants		**75**		**Animal**		**25**	
Provisional ID	**Local name**	**PDM**	**LUVx100***	***Provisional ID***	**Local name**	**PDM**	**LUVx100**
Argostemma sp	Rou' Helalai	12	0.350	*Ursus malayanus*	Praung Mbuea	19	0.369
Dissochaeta gracilis	Raou' Mbyae	12	0.350	*Python reticulatus*	Ngie Penganen	14	0.272
Zingiber purpuracea	Rou' Ya' tengan	12	0.350	*?*	Tue Tana	11	0.214
Aristolochia sp2	Kah Kedayan	11	0.321	*Tragulus napu*	Nayaung Pelanauk	11	0.214
Zingiber officinalis	Rou' Ya' Mla	10	0.292	*Apis dorsata* (honey)	Ngiet Tanyit	9	0.175
Schefflera singalangensis	Kah Kuceih	9	0.263	*Manis javanica*	Ngaeng	8	0.156
Ziziphus angustifolius	Tanpahelaue	9	0.263	*Collocalia fuciphaga sub sp. Vestita* (birds' nest)	Tepleih Lubuye (sarang burung)	8	0.156
Stephania hernandifolia	Rou' Klingiu	9	0.263	*Hystrix brachyura*	Mblung Tao	7	0.136
Tinospora crispa	Rou' Paay	9	0.263	*Mustela nudifes*	Hlangae	7	0.136
Kleinhovia hospita	Kenga'	7	0.204	*Psyconantus zeylanicus*	Manau Bauq	6	0.117
	Total	*100*	*2.917*			*100*	*1.944*
	Remainder	100	2.917			0	0.000

*LUV is the *local user's value*: a relative index that can be compared across classes. All LUVs of all values and products considered add to one.

Table 5.17 Example portion of PDM based on species by importance

Plants		**49**		***Animals***		**51**	
Provisional ID	**Local name**	**PDM**	**LUVx100**	***Provisional ID***	**Local name**	**PDM**	**LUVx100**
Cocos nucifera	Nyau	27	0.315	*Buceros vigil*	Manauk Talau	19	0.323
Artocarpus elasticus	Kayau hmaug	16	0.187	*Ursus malayanus*	Mbuea	18	0.306
Ficus uncinata	Laaung ntaya	12	0.140	*Buceros rhinoceros*	Manauk tekue	17	0.289
Claderia viridiflora	Rou' Mayau	11	0.128	*Cervus unicolor*	Payau	11	0.187
Knema sp.	Lau	10	0.117	*Pardofelis nebulosa*	Tloeh	10	0.170
Schizostachium latifolium	Mblou Ngana	8	0.093	*Agusianus argus*	Manauk Kuao	8	0.136
Calamus caesius	Ngoe Ngka'	6	0.070	*Muntiacus muntjak*	Telaauh	6	0.102
	Rou Kemalah	4	0.047	*Gracula religiosa*	Manauk Kiue	5	0.085
Geunsia pentandra	Kala'	3	0.035	*Python reticulatus*	Pie Pengenan	5	0.085
Kleinhovia hospita	Kenga'	3	0.035	*Tragulus napu*	Pelanauk	1	0.017
	Total	*100*	*1.167*			*100*	*1.700*
	Remainder	40	0.467			0	0.000

This presents ornamental and ritual importances for plants and animals given by older women in Gong Solok (Merap).

Table 5.18 Populations of survey villages

Name of village	Total area (Km²)	Households	Inhabitants	Population per Km²	Larger boats	Canoes, rowboats	Boats per person
Gong Solok I	324	44	208*	0.64*	19	14	0.159
Paya Seturan	22**	25	116	7.05**	11	1	0.103
Rian		9	39		2	0	0.051
Langap	469	99	415	0.88	33	41	0.178
Laban Nyarit	256	29	138	0.54	15	16	0.225
Lio Mutai	370	11	53	0.14	3	4	0.132
Long Jalan	748	31	114	0.15	9	9	0.158
Summary	Total 2189	Total 248	Total 1083	Mean 0.49	Total 92	Total 85	Mean 0.163

*Gong Solok 1 disputes territory with Gong Solok II. The area also includes some Punan families—the population in this territory may be more than twice this figure.
** These two communities share a territory.

Table 5.19 Ethnicity and religion of the sample villages

Name of village	Dominant*	Other*	Moslem	Protestant	Catholic
Paya Seturan	Merap Kenyah	Lundayeh (Putuk)	-	35	-
Rian	Punan	-	-	-	-
Langap	Merap	Kenyah, Bugis, Lundayeh Chinese, Timor-Timur	13	94	308
Laban Nyarit	Merap Punan	Kenyah, Toraja, Lundayeh	-	138	-
Long Jalan	Punan	Lundayeh	-	114	-
Lio Mutai	Punan	-	-	-	53
Gong Solok I	Merap	Lundayeh, Tunjung, Bugis, Punan, Tidung, Brusu	21	30	157

* For simplicity in this report we will not try to subdivide these ethnic groups further. Locally, however, these divisions are significant.

Table 5.20 Occupations contributing to livelihoods in surveyed villages (Adults only)

Principal occupation	Village*							
	PS	R	Lg	LN	LJ	LM	GS	Total
Farmer	24	7	169	50	17	8	78	353
Gaharu collection	-	2	-	36	34	13	-	85
Labourer	-	-	9	8	-	-	7	24
Forestry operations	-	1	13	-	-	-	8	22
Craftsperson	-	-	15	1	-	6	-	22
Teacher	1	-	10	5	-	-	-	16
Private	-	-	9	-	-	-	6	15
Trader	-	-	3	2	1	-	1	7
Priest	-	-	2	1	1	-	1	5
Technician	-	-	4	-	-	-	-	4
Hunter	-	-	1	2	-	-	-	3
CIFOR	-	-	3	-	-	-	-	3
Medical aide	-	-	3	-	-	-	-	3
Gaharu trader	-	-	-	1	1	-	-	2
Birds' nests	-	-	1	1	-	-	-	2
Carpenter	-	-	2	-	-	-	-	2
Livestock farmer	-	-		-	-	2	-	2
Fisherman	-	-	1	-	-	-	-	1
Other	-	-		2	-	-	3	5

*PS = Paya Seturan, R = Rian, Lg = Langap, LN = Laban Nyarit, LJ = Long Jalan, LM = Lio Mutai, GS = Gong Solok.

Lack of education facilities and infrastructure has impacted local education. Literacy is low in some communities such as Laban Nyarit despite proximity to villages with schools. Many villagers, especially older Punan, are not comfortable in Indonesian, and few can read and write (making it necessary for most interviews to involve local translators).

The communities view their economy at the present time as better than it was five or ten years ago. This is principally because of the greater availability of supplemental income from timber and coal companies.

Most villagers are Christian. Only a few Muslims were found to live in the area, and most of these are immigrants. Older community members still concurrently respect animistic traditions and prohibitions, but this practice is declining.

A system of traditional leaders exists in the villages, consisting of a *Kepala adat* (traditional leader) and *Lembaga adat* (traditional council), which enforce community ethics and resolve disputes. In some locations, especially the Punan communities, *adat* is the dominant legal system. If there is any violation of customary law in the community, whether it relates to social relationships or to the environment, the *Lembaga adat* determines the penalty (usually a fine of gongs, money or chickens). In Long Jalan, under current *adat* (2000) no chainsaws are allowed in the territory except by express permission.

Gravesites are highly respected. We found that those of Merap groups are often visible, with older graves associated with large urns, platforms, and

Christianity has arrived in the last 50 years and many conversions have only occurred in the last three decades. When asked what was the best time for hunting, Pak Usak (Seturan) once answered: 'Now that we believe in God, we have no power over the rain [and the mast fruiting that attracts the pigs] anymore. So we just have to wait and see when it pleases God to give us rain.' While in Gong Solok I (DS) was offered both python and monkey to eat. They explained that in the old days people would not eat either but 'now they were Christian it was no longer a problem'. The *Kepala Adat* explained that he himself would die if he ate python as he was 'from the old time' and was still bound by such taboos.

more recently marked ground burials. All forest product collections seem to be prohibited within an area of c. 1 ha or more of such sites, though it was also implied by some informants that this was voluntary. Such sites often survive as remnant forest patches in more intensively cultivated areas. Despite this, the accidental destruction of gravesites by timber concession planners seems common, and has caused local resentment.

Livelihoods and some field stories

Agriculture is based on a swidden system. Fields are usually grouped in clusters, and are sometimes located deep in the forest. Small quantities of coffee, cocoa, and fruits are grown as cash crops in fields near to the village. Areas are cultivated for one or more years, and then left to fallow due to a decline in fertility and invasion by weeds. In many cases specific plant species, such as palms, fruit trees, and honey trees are left in the cleared fields. The subsequent fallow regrowth produces a wide range of products used by community members.

Agriculture appears better developed amongst the Merap than the Punan groups. For the Merap, agricultural activity is communal, while with Punan it is more individual.

Most Punan families generally cultivate some rice, though not in quantities that will see them through the year. During the 'hungry season' when the rice supply is exhausted, there is reliance on forest products and cash savings and an increased likelihood of sickness and malnutrition. Food shortages also occur, to a lesser extent, amongst Kenyah and Merap due to drought flood, or pest infestations.

New technologies, such as chemical weeding and pest control, are being evaluated at a small scale by some community members. We never observed fertilizer use, though it was a topic of casual interest among some farmers. Chainsaws have reduced the labour involved in field clearance.

Local informant (Pak Aran Ngou, Langap) explaining the importance and significant properties of a sample site's soil. People's knowledge is critical in finding areas suitable for cultivation in the region's poor soils.

Table 5.21 Some examples from the questionnaires addressing perception

Information needed and responses given	**Response from local people**						
	PS	R	Lg	LN	LJ	LM	GS I
Heads of households N=	13	13	30	32	30	14	31
Threats of human activities							
Overcutting by logging company	-	-	28	31	3	7	27
Illegal logging	-	-	-	4	-	-	4
Large scale plantation converts land	-	-	1	-	-	-	2
Coal company uses land	-	-	8	-	-	-	
Swidden cultivation-land shortage	5	5	2	9	4	2	7
Overcollection of *Aquilaria* (Gaharu)	10	10	-	-	11	-	-
Bad research (misinformation)	-	-	1	-	-	-	-
Village's property threatened	1	1	-	-	-	-	-
Unsure (no answer)	2	2	-	-	15	6	4
Measures for preventing/controlling threats							
Disease							
Doctor/medical aide			3	27	17	8	29
Traditional medicine			1	10	7	3	9
Medicine from shop			2	3	16	7	-
Unsure (no answer)			25	-	5	-	-
Flood							
Traditional ceremony to stop the flood			-	-	2	-	-
Evacuation to the forest or mountain			4	3	9	9	21
Unsure (no answer)			26	10	2	5	10
Hunger							
Consuming a food substitute such as cassava, sago, etc.			2	13	8	7	20
Collecting *Aquilaria beccariana* (Gaharu), logs, birds' nests etc. (for money)			6	-	1	2	6
Ask for assistance from outsiders and local government			1	-	-	2	4
Unsure (no answer)			20	10	3	3	-
Fire							
Make a 'fire break'			4	1	-	-	-
Extinguish the fire			2	1	-	-	-
Be more careful with fire			1	2	-	-	-
Unsure (no answer)			5	1	-	-	1
Regulation							
Negotiation with the government and/or companies			3	-	-	-	1
Unsure (no answer)			4	1	-	-	1
Reaction to threats							
Disease							
Prepare traditional medicine			1	8	4	5	3
Cook all food			-	1	2	-	1
Bar outsiders from the village			-	1	2	-	1
Keep healthy/clean			2	5	7	1	16
Unsure (no answer)			19	17	15	8	10

Table 5.21 *Continued*

Information needed and response given	**Response from local people**						
	PS	R	Lg	LN	LJ	LM	GS I
Flood							
Traditional ceremony to stop the flood			-	-	1	1	-
Move village site			12	2	-	4	4
Build a farm in the hills			-	132	-	-	4
Unsure (no answer)			18	10	29	9	23
Hunger							
Gardening (planting cassava)			6	6	1	6	22
Collect *Aquilaria beccariana* (Gaharu), timber trees, birds' nests etc. from the forest			2	3	-	1	3
Work for a company			-	-	-	-	1
Keep the birds' nests in the cave safe.			-	-	-	-	1
Expand farming land			-	-	-	-	3
Unsure (no answer)			15	14	28	7	1
Fire							
To make a 'sekat bakar' (fire break)			4	5	-	-	-
To extinguish the fire			-	-	-	-	-
To be careful with fire			1	-	-	-	1
Unsure (no answer)			7	-	-	-	-
General views							
Is life better now than 5–10 years ago?							
Current life is better than before			18	11	24	9	25
Life 5–10 ago was better than at present			4	8	2	5	3
Similar			8	13	4	-	3
Expectations for young generation							
The young can go to school			13	17	21	8	16
The young can work			-	11	2	1	7
The young can advance			16	2	1	2	5
Unsure (no answer)			1	2	6	3	3
Suggested action to be taken if forest resources are degraded or used up							
Replanting			1	4	3	-	1
Protect trees – ban cutting			4	3	7	4	2
Bar outsiders from entering village area			-	-	2	-	-
Keep the forest as a protected area or customary forest			1	2	2	1	9
Limit the area used by companies			3	7	1	-	8
Grow tree crops			16	13	-	3	3
Unsure (no answer)			6	5	13	6	6
Factors important to maintaining forest value							
Birds, because they spread forest seeds			4	-	17	1	4
Bats, because they spread forest seed			-	-	1	-	-
Wild animals as a heritage for grandchildren			1	2	3	-	1
Fruit trees as a heritage for grandchildren			4	11	5	-	13
Ficus sp. (Beringin), because it has mythical associations			-	-	2	-	-
Gaharu tree (*Aquilaria beccariana*), Sago, *Shorea* sp., *Agathis* sp., etc., because of value for the local people.			2	1	3	-	1
Koompassia excelsa for bees nests			4	5	1	1	3
Trees in customary forest			-	1	-	-	2
Unsure (no answer)			17	13	9	12	11

*PS = Paya Seturan, R = Rian, Lg = Langap, LN = Laban Nyarit, LJ = Long Jalan, LM = Lio Mutai, GS = Gong Solok.

Many factors lead to change. Pak Impang Malang (from Langap) recounted that he had been amongst a group of community leaders who met with President Soeharto in Jakarta in the mid 1970s. He presented the president with a stick of ***gaharu,*** (scented *Aquilaria* resin) and in return received a gift of 'wet' rice seed. Prior to that time the Malinau Dayaks had no experience of cultivating wet rice. They still use this rice on a small scale and have called this variety '*padi kantor*' (office rice) ever since.

Apart from cultivation, local economies are strongly based on river and forest products, including fish, timber, rattan, bird nests, *gaharu* and songbirds. Local people consider that logging and mining companies have threatened the sustainability of the local forest, although smaller-scale land clearing for cultivation by communities is also recognised as a problem in areas where villages have limited territory.

Gaharu collection provides a profitable yet risk-laden source of income, as enormous debts are frequently incurred to organise a collecting party, binding individuals to the traders on a long-term basis, and making them highly dependent. While largely a Punan activity, many Merap men seek *gaharu* when they are young.

When a Long Jalan collector makes a large *gaharu* find, many community members will borrow his money. The result is that the money is quickly exhausted. Despite this, a good find can provide a boat engine, a larger house or an electric generator, despite the fact that after a few months the owner frequently can no longer afford the fuel.

Values of sites

The field sites sampled included many with specific importance to our informants. Some of these are associated with specific types of site. In Figure 5.9 we present one summary, classed by distance from the village, showing how sites have been rated in terms of importance for basketry and for heavy construction. Both appear to increase with distance and may imply some local depletion. However, there are caveats about our sampling that would need to be considered before this was interpreted further.

An odd example is the difference between the Merap and Punan in rating the importance of each sample site 'for the future'. Punan respondents consistently rated almost every site as highly important while the Merap showed more differentiation (Figure 5.10).

Figure 5.9. A summary of the value of basketry and building timber according to increasing distance from the village, reported by local informants. These summarise records from five of the seven communities

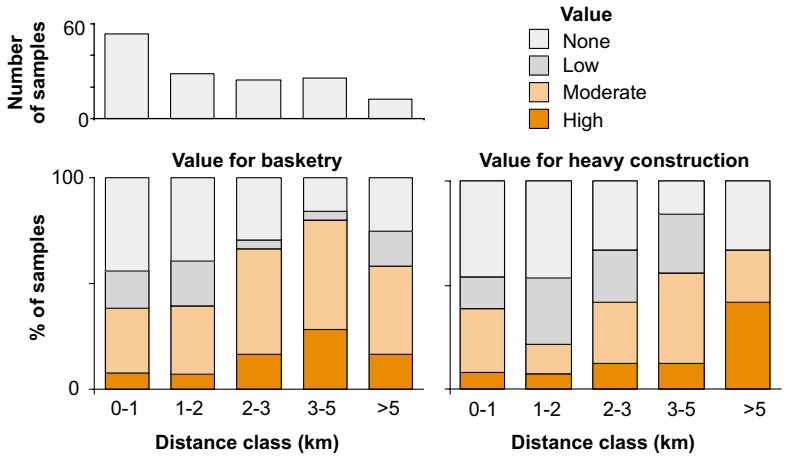
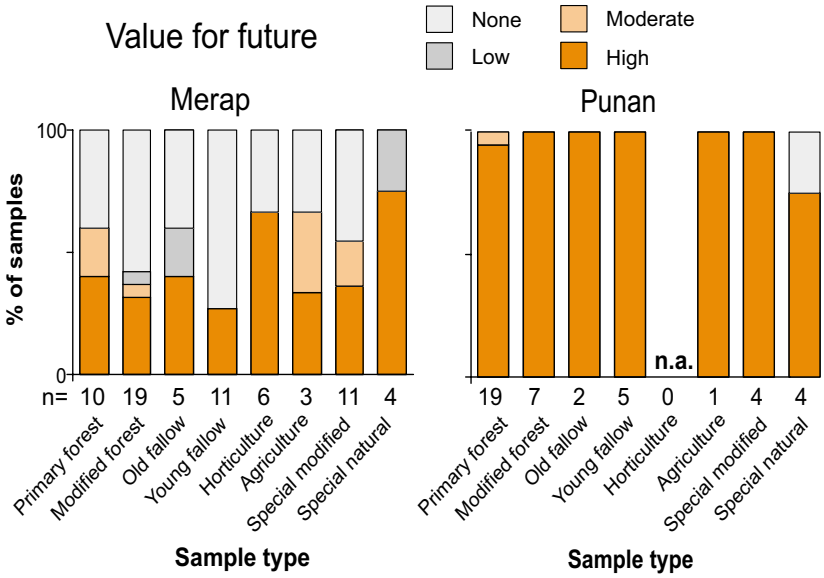


Figure 5.10 A summary of 'importance for the future', reported by Merap and Punan informants in our samples, by site type. These summarise records from five of the seven communities, n.a. = not applicable (see Figure 5.2 for explanation of sample classes)



Soil

Introduction

Soil types varied considerably in the sample area. Much of the landscape is very steep and is dominated by young soils derived from alluvial material.

Most land in the Malinau area is considered by local swidden farmers to be fertile enough to support their agriculture. However, given the high rainfall and nature of the tropical soils, swidden agricultural activity in turn has an impact on soil fertility, as is considered in more detail below.

Description of soil types

Scientific

Five soil types (Soil Survey Staff 1999) were recognised in the survey. Inceptisols were the most common, occurring in more than half of the sites (62.5%), followed by oxisols (27.5%), entisols (6.5%), ultisols (2.5%), and alfisols (1%).

Inceptisols were found to occupy relatively large areas and appear to be the dominant soil type. These young soils are found over a wide range of land formations, including steep slopes and more level terrain. The chemical properties of the inceptisols were varied, presumably due to heterogeneous parent material; in particular, inceptisols in hilly areas were generally less fertile than those in level alluvial regions, due to lower base saturation and pH levels.

Oxisols are deep soils with low CEC (<16 me/100g) due to heavy weathering. These nutrient-poor soils were found across all landforms except swamps.

Entisols were mostly found in flood plains and swamps. Average base saturation was high (67%) and this fertility seems to offer potential for cultivation, but local people often felt that the swampy or stony nature of the entisols rendered them unsuitable for cultivation.

Ultisols were localized and rare but were nonetheless recorded in a wide range of site conditions. These heavily leached soils are acid (soil average pH is 4.5) and have low inherent fertility with only 20% base saturation.

Alfisols were found only in two sites. These rare soils represent the 'best soils' recorded in the area, with high base saturation of nutrients and good depth. The pH value of these soils is nonetheless low (4.7), which could limit cultivation.

All soils have a low to very low intrinsic fertility, with low nutrient content, relatively high acidity, and both low cation exchange capacity (CEC) and base saturation.

Local soil classification/characterisation

Each ethnic group has a distinct soil-based terminology. The Merap appear to have a slightly richer terminology, differentiating the soils sampled into 19 generic types, while the Kenyah and Punan identified 14 and 11 types respectively (see Table 5.22).

Soil fertility

Scientific assessment

All Malinau soils are acidic with mean pH values of 4.5 to 5, typically associated with the immobilization of soil micronutrients (Ca, Mg, P, and Mo), and increased Al and Mn solubility. Most soils are high in Aluminium: Silicate clays (1:1), which possess a low cation exchange capacity (CEC) and nutrient absorption.

Local perception of soil quality/fertility

Local communities, the Merap in particular, have a deep understanding of soil and its cultivation potential. Various techniques are used locally to assess soils. Pressing a blade into the ground and then withdrawing it to observe how the soil sticks to it is a common test. Sticky black soils are considered fertile. Another approach is to determine the temperature of the soil by touch. We have begun an investigation of how local people judge soil quality and a full account cannot yet be given. We use a four-point scale of local fertility assessments determined by examining the following variables: soil colour, texture, stickiness, humus, associated vegetation, and flooding.

Table 5.22 Preliminary compilation of Merap, Punan and Kenyah terminology used to describe and distinguish soils. Note the number of samples per ethnic group (in brackets), which was not equal (Kenyah in particular had very few)

Merap (79)	***Punan (87)***	***Kenyah (34)***	**Indonesian**	**Description**
Tiem	*Punyuh*	*Saleng*	*Warna hitam*	Black colour
Mla	*Mengan*	*Bala*	*Warna merah*	Red colour
Mieg	*Jemit*	*Bila*	*Warna kuning*	Yellow colour
Mbloa	*Mpu*	-	*Warna coklat*	Brown colour
Bau	-	-	*Warna abu-abu*	Grey colour
Toi	*Cerouh*	*Pute*	*Warna putih*	White colour
-	*Pekelet; Bulah*	-	*Warna campuran*	Mixed colour
Yie	-	*Ahit; A'bu;*	*Berpasir*	Sandy
Lumpuem	-	-	*Agak lengket*	Moderately sticky
To'ou	*Nyekadit*	*Pulut*	*Lengket*	Sticky
Plub	-	-	*Sangat lengket*	Very sticky
Petlat; Entat	*Praeh*	-	*Tidak keras*	Not hard
-	-	*Mahing*	*Keras*	Compact
Lepei	-	-	*Tipis*	Shallow soil
Petantaung	-	-	*Datar*	Flat area
Laowe	-	-	*Muara*	Downstream
-	*Awa*	-	*Hulu*	Upstream
Matau	*Batuh*	-	*Berbatu*	Rocky
Talayo	*Pakat/Ancut*	-	*Akar*	Small roots
Pangkah	*Pangka*	*Bawang*	*Rawa*	Swamp
Lohoya	*Taong*	-	*Hutan*	Forest
'Ya	-	*Tihgah*	*Subur*	Fertile
-	*Jiet*	-	*Tidak subur*	Not fertile
-	-	*Bengaheng*	*Tanpa warna hitam, putih dan merah*	No presence of black, White or red colour
-	-	*Panas*	*Panas*	Hot

Local informant (Pak Kirut, Long Jalan) explaining the importance and uses of a sample site's vegetation. The survey recorded over one thousand used and valued species in the Malinau Valley.

Soil colour: Black and mixed-black soils (*tana tiem* [M] or *tana saleng* [K] or *tano punyuh* [P]) are classified as 'very fertile' or 'fertile', while white sands (*tana toi* [M]) are considered to be low in fertility.

Texture: While the highest class of fertility was not defined by texture, moderately sticky texture is believed to denote a fertile soil.

Consistency: A very friable soil is thought to be indicative of high fertility.

Stoniness: The presence of rocks (of any size) is generally believed to be indicative of the 'not fertile' category.

Vegetation: The presence of *Koordersiodendron pinnatum*, *Elmerilia tsiampacca*, and *Alpinia glabra* are taken by local people as indicators of 'very fertile' soil, while the presence of bamboo is an indicator of 'fertile' soil.

Other: in addition, deep soil is considered 'fertile', and flat areas are considered 'very fertile'. Sloping ground is generally 'moderately fertile'. The presence of deep humus also indicates fertility.

Local estimates of fertility are usually described by observed productivity. A Merap informant suggested that 200 tins/ha of dryland rice production indicates a 'very fertile' soil. Punan quoted about 150 tins of rice yield from 4 tins of seed to indicate a 'fertile' soil. A return of 3 tins of seed yielding only 3.5 tins of rice was reported by one informant to illustrate inadequate fertility.

The relation between local and scientific perceptions of soil fertility

The four-point classification of local assessments was found to be significantly correlated with some of our measured soil characteristics, including soil depth, silt and sand percentage, carbon-nitrogen ratio (C/N), nitrogen content (%), magnesium content (me/100gr), exchangeable acidity (H^+) and the Munsell components of colour.

Thus initial analyses suggest that the fertility judgments by Merap appear closer to measured parameters, though this may be influenced by sample distributions; more analyses are required.

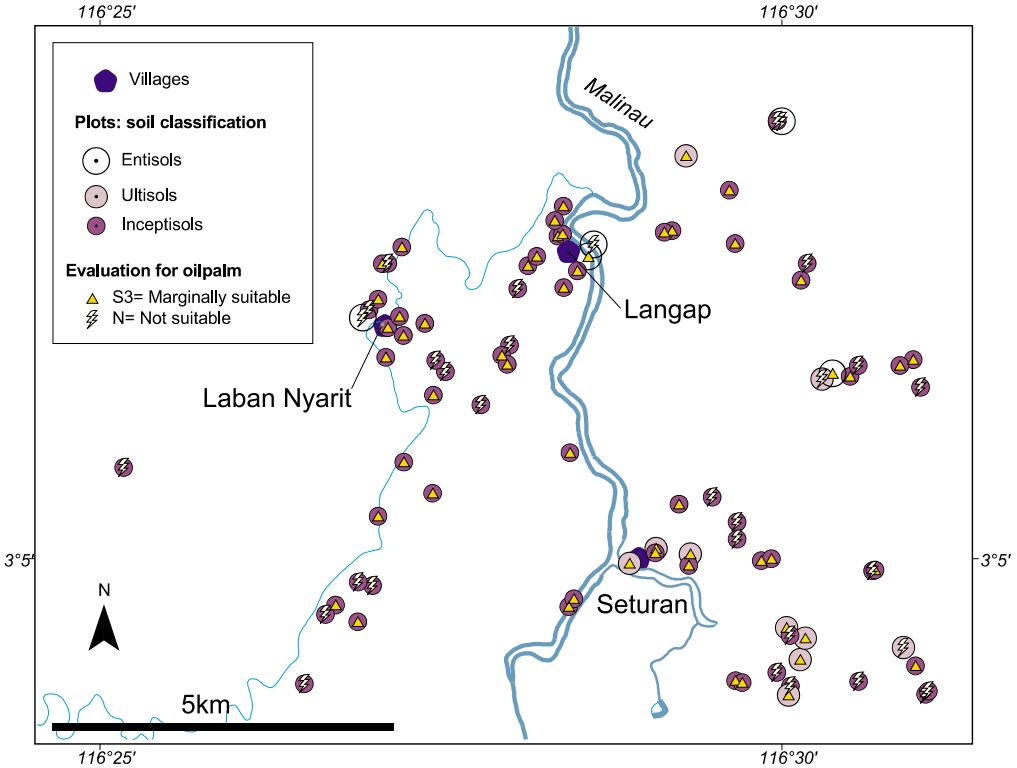
Table 5.23 Significant rank correlations between local fertility perception (very fertile, fertile, quite fertile, and not fertile) and measured soil characteristics (inc. chemical characteristics at 0–20 cm depth)

	Kendall's	N	C/N	Mg	Sand	Silt	H^+	Hue	Value	Chrome	Depth
Local Fertility	Tau Coef.	.174	-.157	.130	-.120	.135	-.096	-.151	-.194	-.137	.119
	p-value	***0.002	***0.006	**0.018	**0.03	**0.015	*0.08	**0.043	***0.009	*0.058	**0.045
	N	197	197	197	195	195	195	141	141	140	197

Table 5.24 Significance determined by Kruskal Wallis Test (df = 3) on measured soil characteristics versus four-point scale of local fertility assessment. (Blank data omitted)

Characteristics	All observations N=197, p-value	Punan only N=84, p-value	Merap only N=79, p-value	Kenyah only N=34, p-value
Sand	0.198	0.436	0.419	0.846
Silt	0.091	0.105	0.259	0.768
Clay	0.669	0.985	0.081	0.770
pH-H_2O	0.314	0.219	0.291	0.108
C	**0.035***	0.245	**0.032***	0.795
N	**0.016****	0.443	**0.001****	0.104
C/N	**0.007****	0.759	0.184	0.172
P_2O_5	0.126	0.368	0.074	0.430
K_2O	0.293	0.749	**0.041***	0.548
Ca	0.426	0.170	**0.001****	0.730
Mg	0.136	0.317	**0.039***	0.200
K	0.267	0.813	0.695	0.353
Na	0.752	0.835	0.318	0.256
CEC	0.597	0.851	**0.019***	0.363
Base-saturation	0.733	0.557	**0.024***	0.614

Figure 5.11 Mapped summary of soil information in the Langap-Laban Nyarit- Seturan area



Main soil orders are shown along with suitability classification for oil-palm. This flood valley area includes many of the best sites for agriculture—most of these sites are already under rice or fallow

Local fertility classes amongst samples appear weakly related to slope, e.g. the Kruskal Wallis Comparison of slope effect on local classes of fertility gives p=0.023 (n=197), indicating that steep slopes are considered less fertile. A weak but significant correlation is found between local fertility assessment and distance from the village, but it is hard to disentangle cause and effect in such a result.

Land evaluation

Scientific assessment

We used soil and site data to make a land evaluation using methods outlined by the Indonesian Ministry of Agriculture (1997) in order to assess each site for potential for field rice, pepper, and oil palm cultivation. Apart from soil quality, many other land characteristics that directly determine productivity and sustainability of a land use were considered. There are four land use classifications: S1—land with no limiting factor for achieving sustainable and optimum output; S2—land with some minor limiting factor(s) and needs input to produce optimum yield; S3—land with major limiting factors that affect productivity and would need more inputs than S2 for optimum yield. N means that the land is not suitable for such crops. All our samples for all three crops were classified as either S3 or N, with more than half in the totally unsuitable N class. While this reflects 'commercial' rather than local cultivation, this tells us that **Malinau is unsuitable for oil palm, and for large-scale pepper and rice farming**. Despite the fact that these soil characteristics would appear to make land unsuitable for commercial cultivation, this has little relations to subsistence use, particularly field rice cultivation.

Local assessment of suitability

Indigenous methods of assessing suitability for particular crops were also recorded, producing a large body of data. Preliminary observations are:

- **Merap.** *Tana tiem* (black soil) is used for the production of dryland rice, corn, banana, butternut, sweet potatoes, cassava and any other cultivation or/and plantation. *Tana toi pangkah* (swampy soils), *tana yie mieg* (sandy soil), and *tana mbla tu'uk* are not fertile and generally remain forested, while the clayey *Tana plub* has been used to develop experimental wet rice fields.
- **Punan.** *Tano batuh* (Rocky soil) is left as forest, while *Tano pangkah* (swampy soils) have been tried for wet rice. *Tano punyuh* (black soils) in Punan sites were used for dryland rice cultivation.

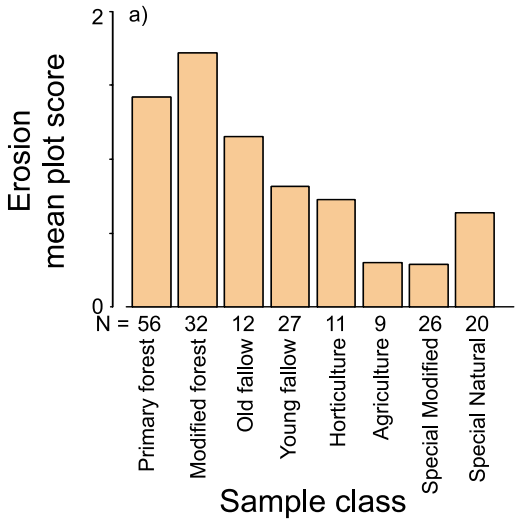
Exploratory analyses, using cross-tab symmetric measures [SPSS], show weak relations between local assessments of land suitability and standard suitability assessment methods (Ministry of Agriculture of the Republic of Indonesia 1997) for pepper and oil palm (both p=0.001, strength/phi value= 0.3), but not for rice (p=0.69, strength/phi value=0.03).

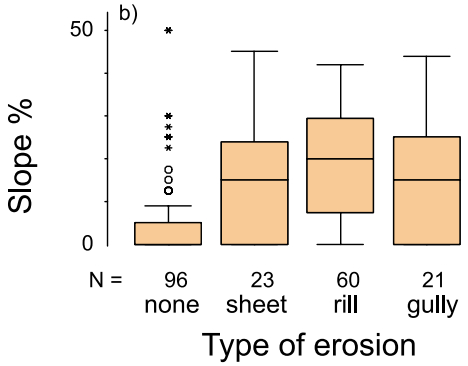
Erosion and compaction

The recorded types of soil erosion are sheet/interrill, rill, and gully types. Rill erosion is recorded in 60 plots, while gully and sheet type erosion are recorded in 21 and 23 plots respectively. Land cover type is related to degree of erosion (by sample type, Kruskal Wallis test, p= 0.001). Modified forest, primary forest and old fallow are the most eroded while agricultural land is the least (Figure 5.12a). The explanation would appear to be that agriculture occurs mainly on flatter areas, whereas modified forest occurs on the steepest terrain. Erosion is positively related to slope (Kruskal Wallis Test, df=3, $p<0.001$, Figure 5.12b). Erosion is also positively related to bulk density (p= 0.05), which is not itself related to slope ($p>0.6$). These observations help explain the relation of woody cover to erosion (Kruskal Wallis Test, df=3, $p<0.001$, Figure 5.12c). The rill type is found under the densest vegetation coverage, while none is observed in more open area—slope again seems to be the explanation.

An initial evaluation of soil compaction is provided by looking at soil bulk-density data (Figure 5.13). The differences are significant (F=3.26, df=7, p=0,003). More specifically, density is higher in modified as opposed to primary forest samples (p value = 0.004, LSD test). The densest, most compacted, soils are often found in sites modified by human activities: logged areas, logging bays, extraction trails and old village areas. The four sample sites with unambiguous reports of heavy machinery use are all amongst the 40 densest soils sampled in the 200 sites (exact probability P=0.0016). These data, viewed in conjunction with the vegetation and site histories, imply that site recovery can be very slow.

Figure 5.12 Erosion scored: a) by severity across sample types, b) by slope, and c) by relascope count—estimated basal area (a measure of tree cover)





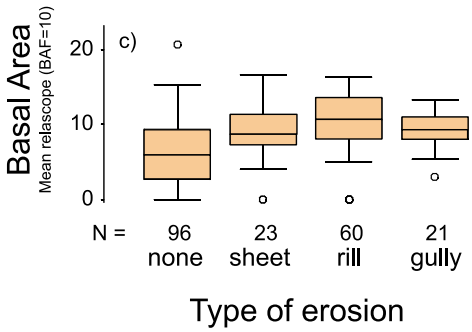
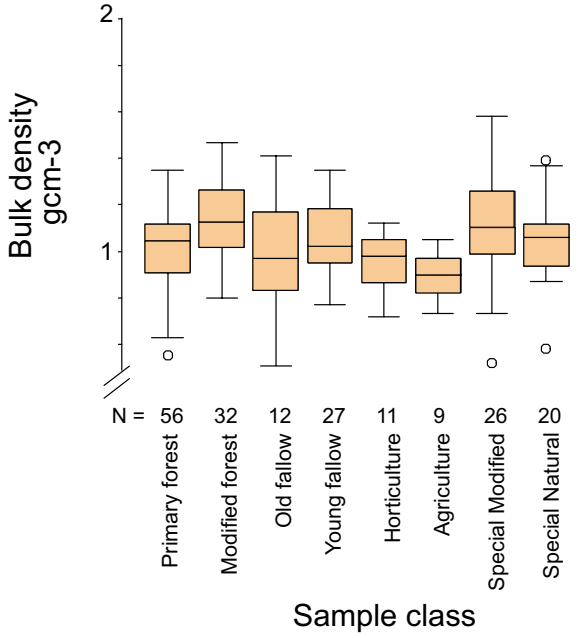


Figure 5.13 Bulk density of the soil surface by sample class (see Figure 5.2 for explanation of sample classes)



Other aspects of sites and generalisations

Soil fertility and suitability for cultivation are major determinants on local livelihood options. Agricultural production would likely show great benefits from the use of fertilizer. Since fertilizer can also increase weed growth, and is likely to be expensive, the management of its application needs to be examined. Soil management to improve organic matter content and raise pH would be useful too. The availability of local limestone may make such recommendations practical. Applications of lime would increase the soil pH value and CEC, and should help mineralise micronutrients.

There is a belief that some locations, especially those with poor drainage, are associated with the spirits and are dangerous for human activities, and these are often avoided, especially at certain times and by people alone. In our studies we found such locations at *air asin* (salt water springs) and *tabau ayo'* (Punan, wide depression area near a ridge top). We found a milder caution associated with some bamboo groves.

Plants—general and ecology

Plant taxonomy and verification

The preparation of a final reference list of vascular from plant records from this survey took considerable herbarium and reference work. The Malinau area is not well-explored taxonomically and the majority of the plants encountered are not easily identified. Even when good herbarium matches have been made, standardising nomenclature and synonymy remains a major task. Though the first stage of the botanical identification has been completed, we still consider the names provisional. From the 15 430 records in the plant reference list, 91% have a complete species name (this is c. 73% of species). The rest, 516 species, are still distinguished taxonomically to identify distinct and consistent morphospecies (usually named [*Genus*] sp1, sp2, sp3 etc.). This required checking and grouping for all such reference specimens. For 51 of the unidentified forms, genus is not known, and for 24, family is unknown (79 specimens).

Some of the incompletely identified material is likely to include rare or previously undescribed taxa. We anticipate, in particular, that additional expertise will allow us to identify unnamed material, and likely cause us to revise some of the lesser-known taxa. In some groups, e.g. Zingiberaceae (gingers), taxonomy itself is confused and needs revision. We collected at least one probable new species, a fruiting tree (genus *Mammea*, family Clusiaceae).

Vegetation ecology

Our field methods emphasize trees, herbs and climbers, but also encourage limited observations of other life forms. Records are summarized in Table 5.25. Some classes overlap at species level.

The number of records per species is highly skewed. Single records were made for 735 taxa, two records for 262 etc. Figure 5.14 shows this as a log-log plot. Such a relationship indicates that additional sampling efforts would continue to discover additional species, and that our 2126 is part of a potentially much higher total.

The sampling effort was not evenly distributed across all types of habitat (See Figures 5.2 and 5.3 and Table 5.26). More effort was made to collect primary and modified forest than other types, though special sites and post swidden fallow are also well represented. However, if we examine the rarer species, it is clear that the special natural sites and forests generally give more such species per sample, suggesting these as being the most likely areas in

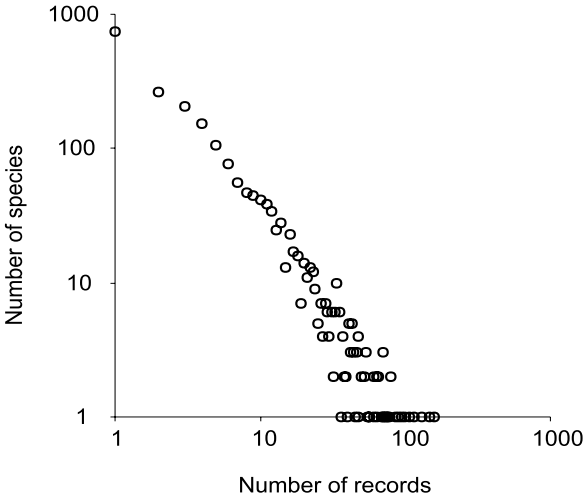
Table 5.25 Overview of number of identified taxa per life form

Life form	Families	Genera species	Unique records	Individual
Aquatic	1	2	2	2
Herbs (not ferns)	48	179	378	2527
Trees	80	280	957	6460
Liana (woody climber)	59	143	348	2350
Non-woody climber	43	107	211	927
Climbing figs	1	1	31	102
Terrestrial fern	26	53	113	643
Climbing ferns	11	13	16	99
Epiphytic ferns	14	21	43	131
Other epiphytes	11	26	38	77
Giant monocots	11	36	67	310
Palms	1	13	69	440
Pandanus	2	3	22	100
Sapling	46	108	227	477
Seedling	37	88	176	418
Shrub or treelet	40	69	125	367
Total vascular plants	*173*	*693*	*2126*	*15 430*

Table 5.26 Plant records by sample type. The fuller explanation to these classes is given under Figure 5.2

	Primary forest	Modified forest	Old fallow	Fallow	Horti-culture	Agricul-ture	Special-natural	Special-modified	Sum
No plots	57	32	13	27	11	10	22	28	200
No plant records	4670	2861	1059	1785	875	374	1785	2021	*15430*
No species	1200	951	479	562	300	187	791	769	*2126*
***N = species recorded once in survey**	229	128	47	71	42	28	99	91	*735*
***N/plots**	4.02	4.00	3.62	2.63	3.82	2.80	4.50	3.25	3.68

Figure 5.14 Number of species recorded by number of separate records per species for the entire 200 samples. Number of species (Y) versus records (X) is closely fitted by $Y= 1077.4X^{-1.56}$ ($R^2 = 0.9138$)



Sample lines are established to guide the vegetation assessment. Here a limestone site is being evaluated by Dr Kade Sidiyasa and Zainal Arifin from Wanariset Sambodja

which to discover additional species with any further sampling. This underlines the efficiency of including such sites in a biodiversity survey.

A cross comparison of the different species according to land use class also highlights these differences (Table 5.27). For example, primary forest samples contain approximately half of the species in each other class.

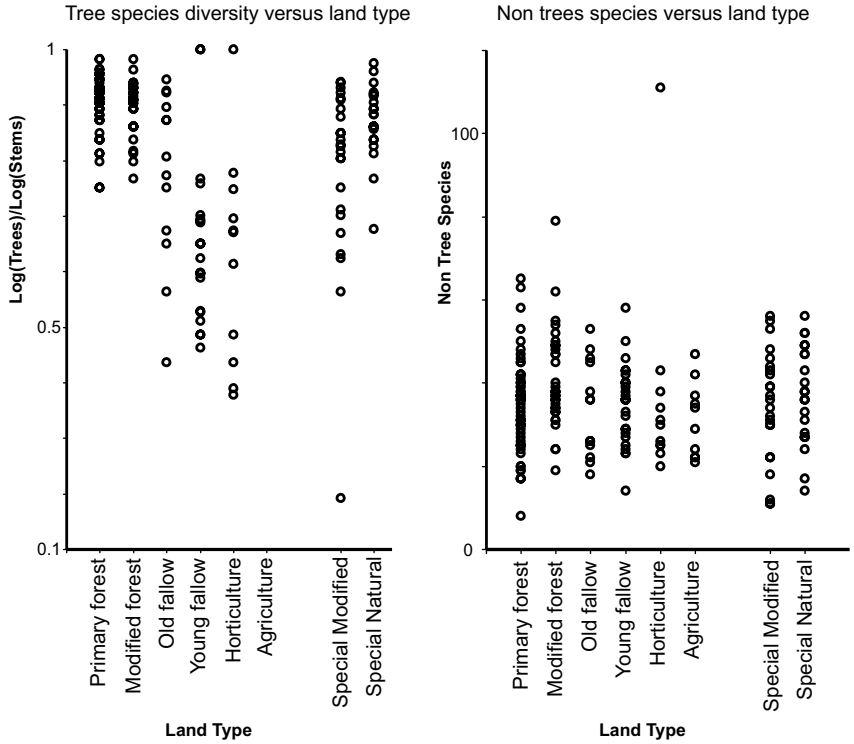
It is perhaps more ecologically meaningful to examine the species richness patterns per plot. In Figure 5.15 the tree diversity and non-tree transect species records are summarised by plot type. The tree richness of primary or lightly disturbed forest is generally higher than other tree communities, but sometimes incomplete clearance leaves quite rich communities of forest trees albeitit at lower densities.

Patterns amongst non-trees are less clear, with considerable variation apparent in all sample classes. Dividing species into different morphological/ ecological types helps clarify this. In Figure 5.16 we see that different groups relate in different ways with tree cover (basal area). Ferns and other herb species-densities seem to benefit from less tree cover, while lianas, palm life forms, and trees themselves increase in life richness with tree cover. These patterns do not necessarily hold over all data ranges or sample types, and may not be monotonic in nature—for example the richest herb communities are found in sites with some (not zero) tree cover.

Table 5.27 Shared species by class of samples. The class given in the row shares the number of species with the class given in the column; percentages are based on the row class (see Figure 5.2 for explanation of sample classes)

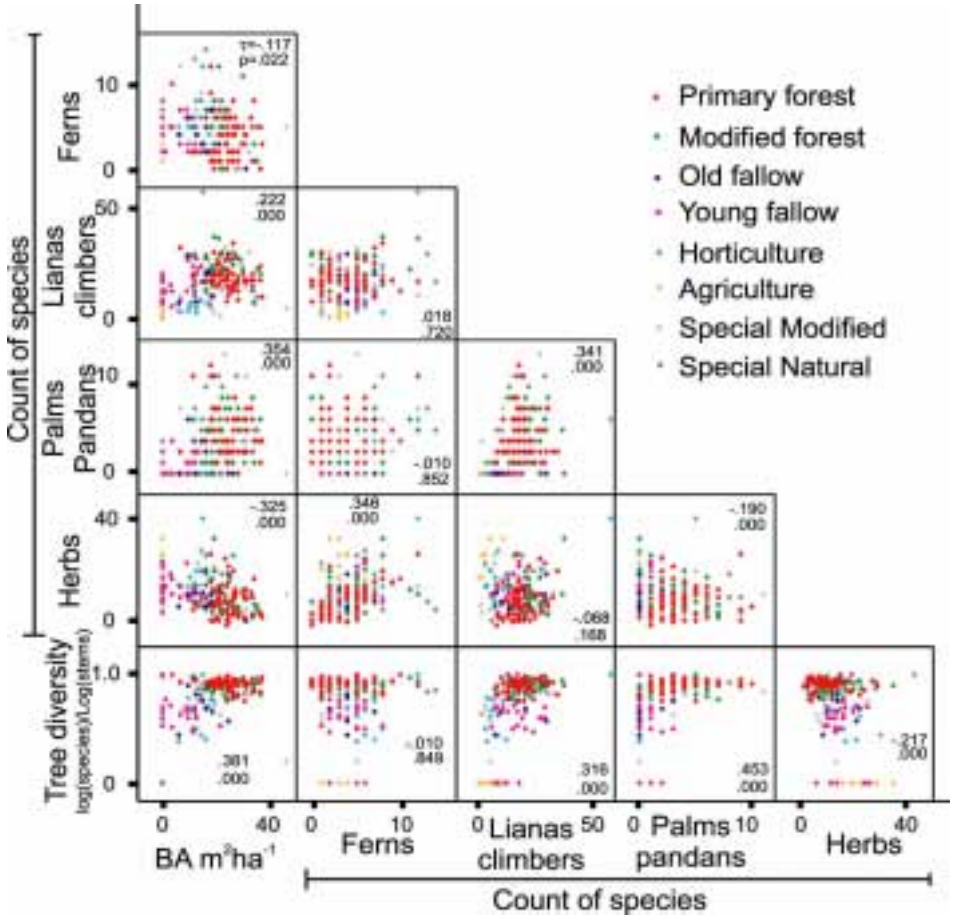
	Primary forest 57	Modified forest 32	Old fallow 13	Fallow 27	Horticulture 11	Agriculture 10	Special-natural 22	Special-modified 28
Primary forest	1200	634	329	325	142	59	529	479
%	*100.0*	*52.8*	*27.4*	*27.1*	*11.8*	*4.9*	*44.1*	*39.9*
Modified forest	634	951	305	310	158	69	478	426
%	*66.7*	*100.0*	*32.1*	*32.6*	*16.6*	*7.3*	*50.3*	*44.8*
Old fallow	329	305	479	229	126	65	276	280
%	*68.7*	*63.7*	*100.0*	*47.8*	*26.3*	*13.6*	*57.6*	*58.5*
Fallow	325	310	229	566	157	123	276	292
%	*57.4*	*54.8*	*40.5*	*100.0*	*27.7*	*21.7*	*48.8*	*51.6*
Horticulture	142	158	126	157	299	72	133	178
%	*47.5*	*52.8*	*42.1*	*52.5*	*100.0*	*24.1*	*44.5*	*59.5*
Agriculture	59	69	65	123	72	187	79	108
%	*31.6*	*36.9*	*34.8*	*65.8*	*38.5*	*100.0*	*42.2*	*57.8*
Special- natural	529	478	276	276	133	79	791	401
%	*66.9*	*60.4*	*34.9*	*34.9*	*16.8*	*10.0*	*100.0*	*50.7*
Special- modified	479	426	280	292	178	108	401	769
%	*62.3*	*55.4*	*36.4*	*38.0*	*23.1*	*14.0*	*52.1*	*100.0*

Figure 5.15 Tree and other plant species richness by sample class. Tree diversity is expressed as Log(species count)/Log (stem count) following Sheil *et al.* (1999)



Primary forest tends to be richer for trees than other land types, but in many partially cleared or damaged areas these rich forest tree communities remain. The richest plot for non-trees is much richer than any other plot. This is a poorly maintained coffee garden in opened forest on steep ground, with many remaining tree stems, and closed forest within 50 m, combining forest remnants, forest regrowth, weeds and streamside species (see Figure 5.2 for explanation of sample classes)

Figure 5.16 An exploratory examination of the relationships between species richness in various species groups in various sample locations



Species classes include ferns, lianas and climbers, palms, pandans, herbs, tree richness and plot basal area. Many strong correlations both positive and negative are seen (Kendall's Tau, given in each figure with a P value beneath). These patterns are readily explained, but also show the complexity involved in using richness in any specific life-form as a surrogate for others. Trees, lianas and palms all do well in closed forest, while ferns and herbs generally reach higher species densities in more open habitat. See Figure 5.2 for explanation of sample classes.

Plants—use

Table 5.28 shows the number of informants, distributed by gender and ethnicity, who assisted us regarding the use of plants. It was easier to find male than female informants willing to take part in the field data collection, but the field team worked with one of each whenever possible.

A very large number of plants and uses/values were recorded (17 603 records). This included 2052 separate species-uses/values in around 1457 species (not including some Kenyah records from the pilot survey). Of these species, 779 were trees, and 620 were herbs and climbers. The number of specific species-uses per use-class is illustrated in Figure 5.17. Firewood and 'hunting place' (species noted for providing food for hunted animals) classes elicited especially long species lists. Yet eliminating these classes only reduces the total useful species lists by

Table 5.28 Number of local informants that accompanied the field team

Ethnicity/gender	Merap	Punan	Total
Male	15	10	15
Female	8	6	14
Total	*23*	*16*	*29*

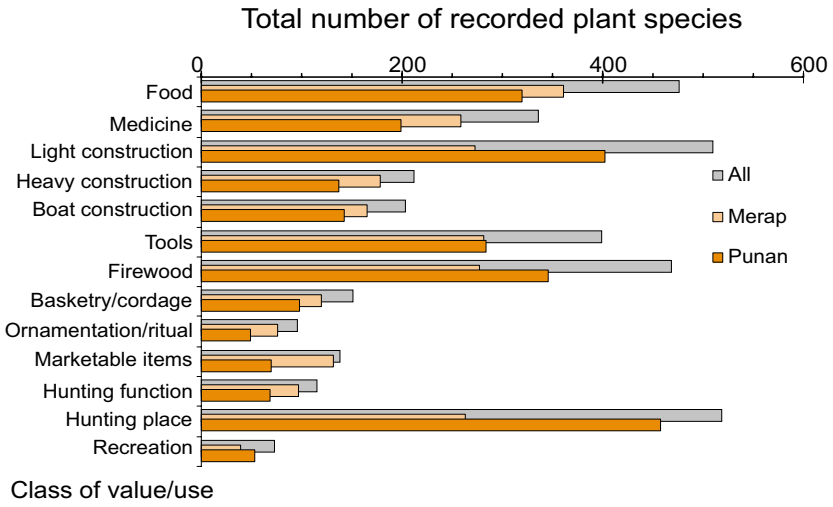
N.B. Three male Kenyah informants were also involved in the pilot study.

Table 5.29 Distribution of plots by type and ethnicity. These sample classes are discribed in Figure 5.2

Sample type/ Primary Ethnicity	Modified forest	Old forest	Fallow fallow	Horti-culture	Agri-culture	Special-natural	Special-modified	Total
Merap	34	24	10	22	11	8	14	21	144
Punan	41	13	8	9	5	6	15	15	112
Total	*57*	*32*	*13*	*27*	*11*	*10*	*22*	*28*	*200*

N.B. Merap and Punan plots do not sum to 200 as in many plots, both were involved.

Figure 5.17 Total number of specific species-uses (Merap and Punan) recorded by value-class. These use classes are described in Table 5.2



117 to 1340 (677 trees and 601 herbs). 119 species were recorded as having values that were in some way viewed by the informant as exclusive to that plant alone—these relate to diverse genera, and encompass 85 families—such records are mainly in the ritual/ornamental, medicinal and tools use-classes (37, 28, 25 species respectively) and are much more commonly reported by Merap than Punan informants. There were no exclusive uses/values recorded in construction or boat building.

As with the ecological data, a different perspective can be gained by looking at the data on a plot-by-plot basis. In Figure 5.18 the total proportion of useful/valued species has been plotted by sample type and ethnicity of the informants. The result is striking in that so many plots have such a high

Table 5.30 Total number of records and taxa of valued plants

		Trees	Herbs etc	Monocots	Saplings	Seedlings	Shrubs	Total	Total (exc*)
Merap	Family	66	90	8	29	27	21	**131**	**128**
	Genus	221	255	28	59	55	28	**478**	**458**
	Species	611	512	44	103	95	46	**1176**	**1043**
Punan	Family	71	83	7	34	26	19	**125**	**122**
	Genus	217	218	19	60	47	33	**432**	**415**
	Species	598	420	27	95	70	46	**1060**	**976**
Combined	Family	73	94	8	37	28	28	**136**	**134**
	Genus	249	286	30	79	63	44	**528**	**515**
	Species	779	620	50	148	116	69	**1457**	**1340**

*Total when 'firewood' and 'hunting place' uses are excluded.

Table 5.31 Total records for plant uses/values reported to be exclusive to a single species

Ethnicity	*Taxa*	Trees	Herbs etc	Monocots	Saplings	Seedlings	Shrubs	*Total*
Merap	Species	20	79	7	4	1	1	106
Punan	Species	9	26	5	2	0	0	40
Total	Family	21	57	8	5	1	1	85
	Genus	24	74	8	5	1	1	106
	Species	24	87	8	5	1	1	119

Table 5.32 Number of different plant uses/values per use-class (see Table 5.2 for explanations)

Ethnicity	Food	Medicine	Light construction	Heavy construction	Boat construction	Tools	Firewood	Basketry/cordage	Marketable items	Ornamentation/ritual	Hunting function	Hunting place	Recreation	Total
Merap	361	259	273	178	165	281	277	120	76	132	97	263	39	1,176
Punan	320	199	402	137	142	284	346	98	49	70	69	458	53	1,060
Total	476	336	510	212	203	399	469	151	96	138	115	518	73	1,457

Table 5.33 Total records for plant uses/values reported to be exclusive to a single species by class of use

Ethnicity	Food	Medicine	Light construction	Heavy construction	Boat construction	Tools	Firewood	Basketry/cordage	Marketable items	Ornamentation/ritual	Hunting function	Hunting place	Recreation	Total
Merap	9	28	0	0	0	18	0	5	35	7	11	0	1	106
Punan	3	1	0	0	0	17	0	5	11	2	4	0	0	40
Total	*12*	*28*	*0*	*0*	*0*	*25*	*0*	*7*	*37*	*7*	*12*	*0*	*1*	*119*

proportion of useful species. If we look within a single use-class the picture is less clear, as is the case with food (Figure 5.19) and medicinal importances (Figure 5.20). We are not ready to interpret all these patterns but the obvious and expected trends (e.g. more useful trees in horticulture) give credibility to seeking explanations for more subtle differences. 'Ornamental/ritual' and 'hunting place' (Figure 5.21 plots these as 'plot-mean' importances) are illustrative of two very different patterns. The first class is scarce and suggests a 'fallow' focus. The second points to likely differences in the ecological knowledge of the Merap and Punan.

Finally, we may ask if vegetation that is richer in species is richer in uses/values. The answer from initial analyses is yes (see Figure 5.22). The proportion of useful species increases in rough proportion to the overall species count (this monotonic relation is highly significant at $P<0.001$, by tree and non-tree vegetation for both ethnic groups). There are no obvious patterns, for either trees or non-trees, of plot richness versus proportion of useful species.

Figure 5.18 Scatter summary of the per-plot proportion of all valued/useful species recorded by plot type, according to Merap and Punan informants (see Figure 5.2 for explanation of sample classes)

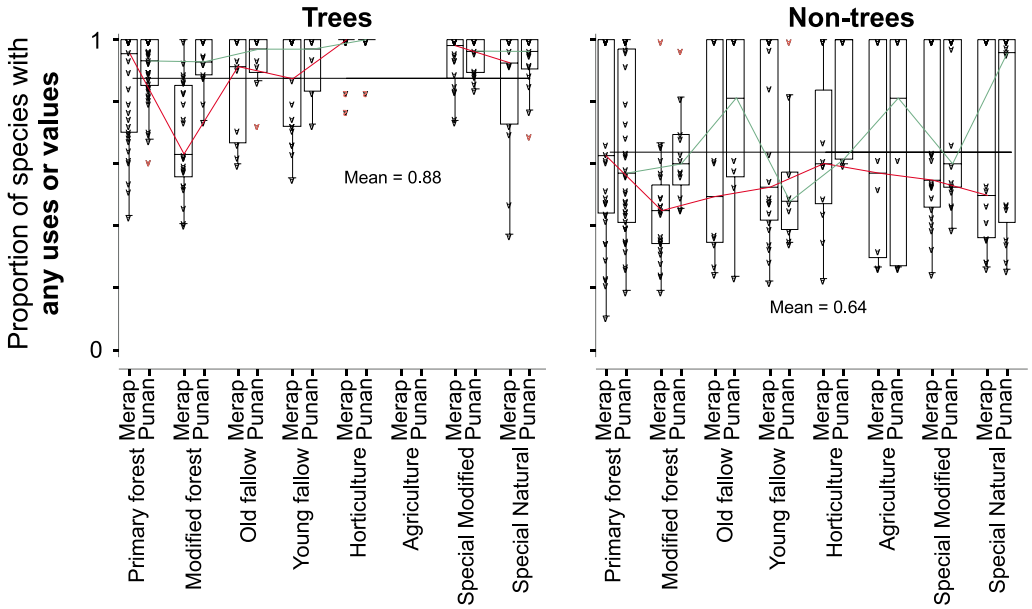


Figure 5.19 Scatter summary of the per-plot proportion of all food-value species recorded by plot type, according to Merap and Punan informants (see Figure 5.2 for explanation of sample classes)

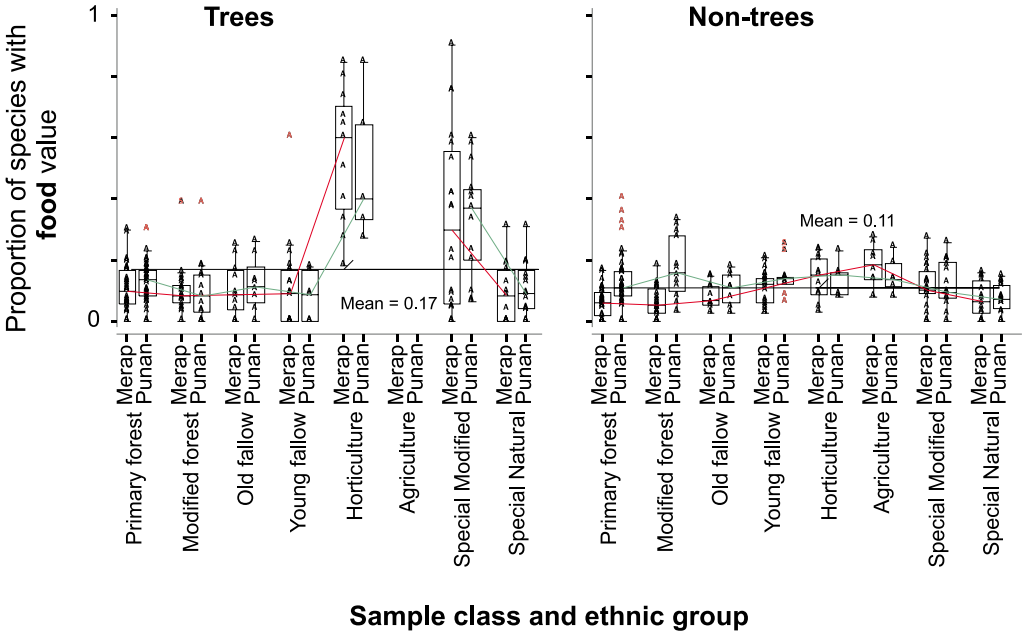


Figure 5.20 Scatter summary of the per-plot proportion of all medicinal-value species recorded by plot type, according to Merap and Punan informants (see Figure 5.2 for explanation of sample classes)

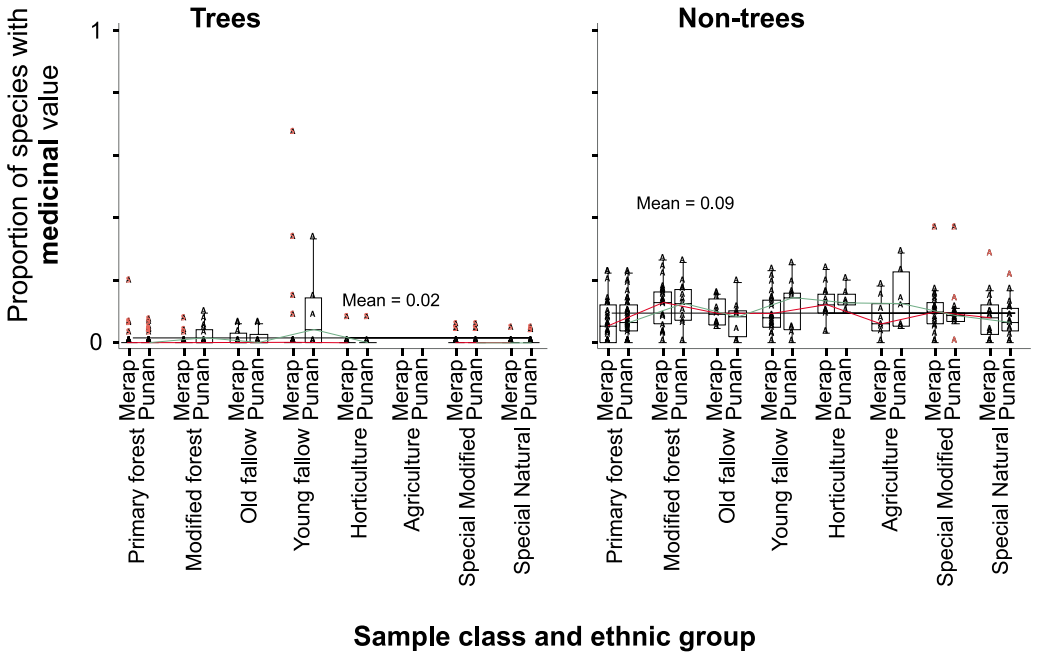


Figure 5.21 Summary of the mean per-plot proportion of useful species recorded by plot type according to Merap and Punan informants for value classes 'ornamentation/ritual' (a, b) and 'hunting place' (c, d) (see Figure 5.2 for explanation of sample classes)

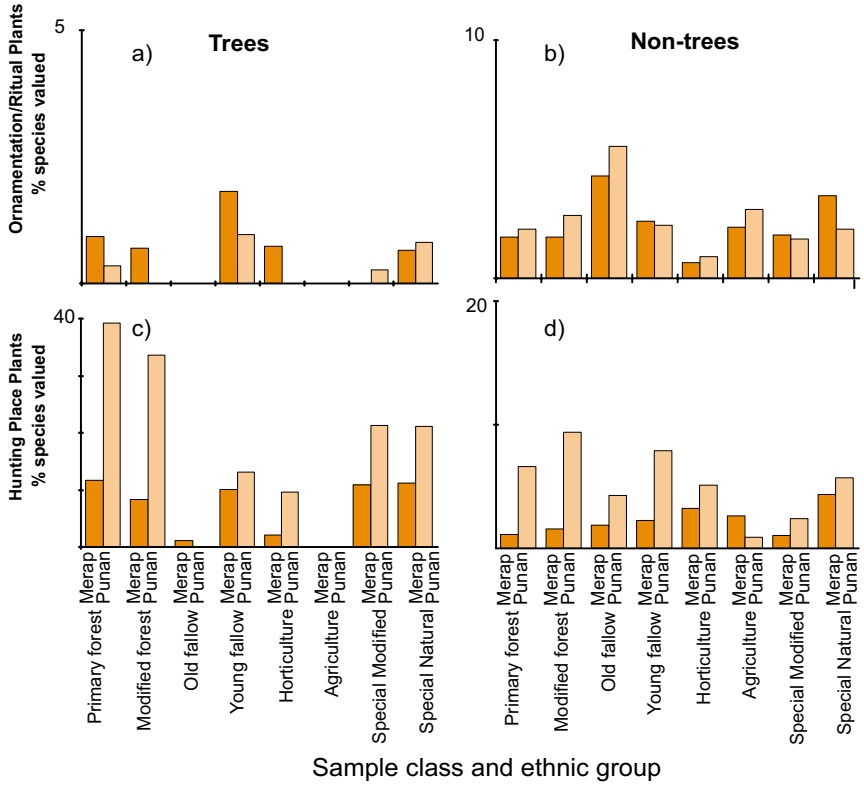
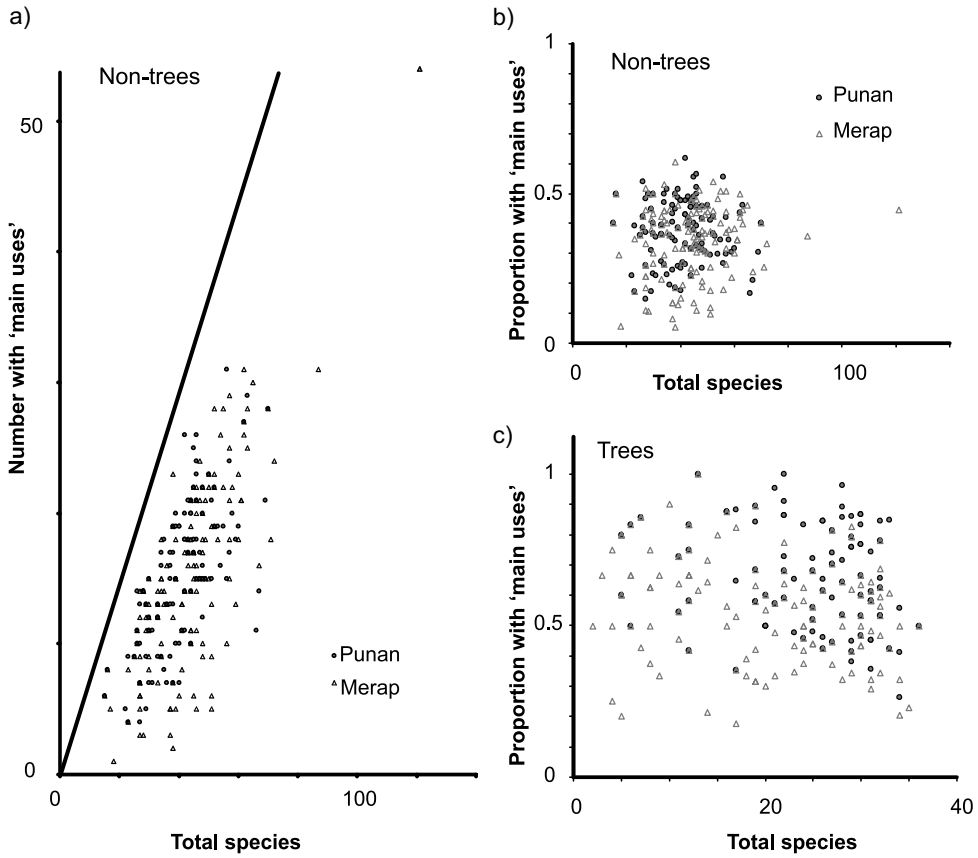


Figure 5.22 a) Plot species richness versus species use. The line is 1:1. While the number of useful species is closely related to the total number of recorded species, there is no clear relationship between community richness and proportion of species used for either trees or non-trees (see b,c). 'Main use' values noted here are all classes except firewood and 'hunting place'.



General conclusions

Many people perceive a decline in important resources, especially the animals they hunt for food and plants they rely on for daily needs and trade.

A shortage of preferred construction materials (e.g. 'ulin' *Eusideroxylon zwagerii*) and boat building materials is already being felt in Seturan village. People from the nearby village of Tanjung Nanga, who are in an even worse position, have been caught stealing timber from Seturan lands. Much of the 'ulin' in the Tanjung Nanga territory has been harvested and, in addition, a fair amount may have been lost in a large fire in the early 1980s. One interesting response to this resource depletion is that in Seturan some communities promote *de facto* protected areas where there is mutual agreement on the need to keep forest cover.

Unlogged forest is considered the most important land for communities, with wild pigs and timber trees amongst the most important species found there. Logged-over forest is given a low preference by local communities. There appear to be a number of reasons for this. These include a diminished level of key resources, reduced physical accessibility and reduced access rights. For example, timber resources for local building are no longer accessible even though these areas are often close to the communities. Even if they had the right to cut the timber the best wood has often been taken already and the damage to the forest makes access difficult. Pigs, a preferred food species, are said to be reduced in logged areas. Certain emergency forest foods, such as sago, are reduced unnecessarily by logging. *Eugissonia*, the most important sago, which grows on ridge tops, is often damaged by skidtrails.

The practice of understorey slashing in logged compartments has hurt local communities and forest biodiversity. Government logging regulations (TPTI) require timber companies to repeatedly slash all undergrowth and climbers (which include many useful and prized species such as rattan), in an effort to encourage regeneration within the concessions. Our observations show that understorey cutting is widely applied as a blanket prescription, but timber seedlings are often slashed along with the rest. Even if applied properly, its silvicultural benefits are dubious and the biodiversity impacts are considerable. The policy should be revoked.

Fish

The main survey did not directly assess aquatic resources, recognising that a different sampling approach and specific expertise were required. To address this Ike Rachmatika was hired from LIPI to undertake a study of fish fauna with a similar emphasis to the main surveys. Again, the linking of species and ecology information with local needs and preferences was emphasised.

The first survey, conducted from November to December 1999, coincided with the rainy season. The second survey, conducted from October to November 2000, started before the rainy season was fully underway and the water levels were generally low. In the first survey fish were sampled from 46 sites, while 59 sites were sampled in the second period. Electro-fishing (10 A, 12 V) was employed for about one hour per sample site. In deeper water, this was combined with ten cast nettings. Apart from this regular sampling, additional specimens were collected using hook and line, at night. Information on fish diversity was also obtained by examining the catches of people in Seturan village. Interviews using illustrated books also added to information. Specimens of all collected species were preserved and taken to the Fish Section, Balitbang Zoologi at LIPI's Research and Development Center for Biology for analysis.

Forty-seven fish species, in 33 genera, 13 families and three orders were recorded. Carps (Cyprinidae) dominated, followed by hillstream loaches (Balitoridae) and bagrid catfish (Bagridae). Fifteen recorded species (31.91%) are Borneo endemics (*Garra borneensis, Hemibagrus baramensis, Puntius sealei, Nematabramis everetti, Parhomaloptera microstoma, Protomyzon griswoldi, Leptobarbus melanotaenia, Homaloptera stephensoni, Betta unimaculata*, *Gastromyzon* cf.*lepidogaster, Gastromyzon* sp, *Neogastromyzon* cf. *nieuwenhuisi*, *Clarias anfractus, Parawaous megacephalus* and *Ompok sabanus).* The genera *Gastromyzon* and *Neogastromyzon* are endemic to Borneo. Many of the hillstream loach species had not been previously known to inhabit the survey area.

Two new forms, a *Puntius* and a *Gastromyzon,* were found in Seturan and Rian Rivers and appear to be undescribed species.

Garra borneensis was the most abundant species in the both samples, and *Nematabramis everetti* and *Garra borneensis* were the most widely distributed in 1999 and 2000 respectively.

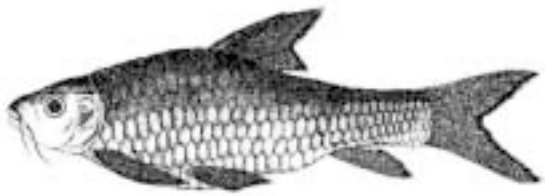
Local informants were able to identify 45 fish species shown to them in pictures. However, small species such as *Pangio anguillaris*, *Parhomaloptera microstoma*, *Protomyzon griswoldi* and *Betta unimaculata* were usually recognised by only the more experienced.

Using a PDM type approach, villagers were asked to rate fish according to the following categories: 'most commonly caught fish', 'most often eaten fish' and 'most preferred fish' Despite the potential for overlap between classes, the differences were illustrative.

The most prized fish are usually those which have fewer bones and can attain a large size. The larger species include *Hampala macrolepidota*, *Tor tambra* and *Tor tambroides*, *Barbodes balleroides, Barbodes* sp., *Leptobarbus melanotaenia* and *Osteochilus kahajanensis*, all of which are widely eaten. *Tor* spp. *(Tor tambra* and *Tor tambroides,* Figure 5.23), are the preferred fish in Seturan and Loreh village and rank a close second to *Pangasius* in Langap. Other popular species include *Leptobarbus melanotaenia*, *Osphronemus* sp., *Barbodes balleroides* and *B.schwanenfeldii*, *Hampala macrolepidota)* and *Lobocheilus* cf. *bo*. *Pangasius*, *Barbodes* and *Tor* are reported as the most important species in the diet in Seturan, while *Barbodes* spp. and *Cyclocheilichthys armatus* are top in Langap, and *Clarias, Ompok* and *Hemibagrus* are the most eaten in Loreh.

Pangasius sp. was not recorded during the sample survey. Local informants said this species migrates annually upstream from the lower reaches

Figure 5.23 *Tor tambra* and *Tor tambroides* are generally the preferred fish in the diet of most people interviewed in the Malinau valley



These much sought-after species are highly forest dependent, eat fruit, are intolerant of siltation, and have low reproductive rates, making them vulnerable to forestry interventions and overfishing.

of the Malinau River up the Seturan River, during the dry season. This species is in high demand and locally expensive, and is said to be increasingly rare in the Seturan watershed.

While some preferred fish are sold or bartered, most people catch fish for their own domestic consumption. Men and women fish differently. Men generally use gill nets (*pukat*), cast nets (*jala*), spool and line (*pancing*) and spears (*tumbak*). Women use dip nets (*tangguk*), traps (*bubu*), and spool and line (*pancing*).

Tor spp. are present in both the Seturan and Rian Rivers. The adults live in deep clear pools while the juveniles live in shallower tributaries. These are important food species and are indicators of both relatively undisturbed forest and good water quality. They are frugivorous and are believed to be associated with the presence of *Dipterocarpus* or *Ficus* growing along the bank. These fish should be viewed as vulnerable as they require clear water, are dependent on forest vegetation, are easily caught, have a relatively low fecundity and are keenly sought. *Tor* spp. are not the only important species with an apparent reliance on forest habitat. Other frugiverous species include the sought-after *Pangasius, Osphronemus goramy* and *Leptobarbus*.

Some fish are also believed to have medicinal value. Eating *Clarias anfractus* is believed to help woman recover after giving birth. The spiny pectoral fin of *Hemibagrus* cf. *nemuru,* is used to treat toothache, while the second dorsal fin of this species can be used to counter an injury caused by the spiny pectoral fin of the same fish. The mashed flesh of *Puntius* sp. is applied to caterpillar stings.

Between the 1999 and 2000 surveys there was a slight decrease in the abundance of several species consumed by people (*Barbodes* cf. *balleroides, Hampala macrolepidota, Leptobarbus melanotaenia, Osphronemus septemfasciatus, Tor tambra, T.tambroides* and *Lobocheilus* cf. *bo*.). However, with only two time points, small sample sizes (and different weather in the sampling periods) such differences are not yet adequate evidence to claim any general decline.

Seven species were not found in the logged areas in 2000: *Garra borneensis, Homaloptera stephensoni, Leiocassis* sp., *Neogastromyzon* sp., *Mastacembelus unicolour*, and *Tor tambra*. The ecology of these fish is not well known. However, this survey suggests that *Leiocassis* sp. and *Mastacembelus unicolour* prefer living in rock- or gravel-bottomed areas and are likely intolerant of siltation.Several other species are identified as sensitive to siltation, including: *Gastromyzon lepidogaster, Anguilla malgumora, Nemachilus* spp. and the shrimp species *Macrobrachium* spp. The absence of *Tor tambra* and *Garra borneensis* in the logged areas is probably not a result of forestry activities, as the sampling localities constituted unsuitable habitat, with small shallow forest streams with muddy-sandy substrate. These species require sufficient water depth, current and a gravel-rocky substrate. Similarly, *Neogastromyzon nieuwenhuisii* and *Homaloptera stephensoni* require faster, clear water.

Poor road construction and blocked culverts often leads to large bodies of still water called 'Ponding'. Three species were abundant in the ponds observed: *Cyclocheilichthys armatus*, *Nematabramis everetti* and *Puntius binotatus*. These are common species.

The water quality in streams in the logged areas (including dissolved oxygen, pH and water temperature) was little different from unlogged areas. All variables seemed acceptable for fish survival. Overall, suspended matter detected in the logged areas, and downstream, varied from 20 to 70 mg/l in 1999 (which is below the threshold value of 80 mg/l considered detrimental to fisheries). By the 2000 survey, however, water clarity in previously logged plots had already improved again and siltation was flushed away.

Several local species seem to have potential for cultivation: *Osphronemus septemfasciatus, Leptobarbus melanotaenia, Tor* spp, and *Osteochilus*

kahajanensis (for food); and *Betta unimaculata*, *Puntius* sp, *Puntius sealei, Osteochilus waandersii,* and *Rasbora* spp. (as ornamentals). However, the practicality of such developments has not been assessed.

Reptiles and amphibians

Amphibians and reptiles were investigated in the area of the CIFOR station and Seturan River during June–July 2000 in research led by Djoko Iskandar from the Bandung Institute of Technology. Seventy-eight species were recorded. Specimens confirmed 51 species, and this was later raised to 65 by additional sampling by two students from Aberdeen (Dyfrig Hubble and Duncon Lang). Not all determinations are complete. By combining data and information from local people, over 125 species of amphibians and reptiles are potentially present in this area. The area is relatively poor in individuals, but species diversity appears high with new taxa being located continuously, up to the end of the field period. Local people had knowledge about many of these but made limited use of them. At least two species representing genera *Ansonia* and *Limnonectes* appear new to science. Only one species of crocodile occurs, though these are very rare.

Although a number of amphibians and reptiles are occasionally hunted as food, they are given low preference in comparison with pigs or indeed with most other mammals. Local people eat four frog species of the frog genus *Limnonectes* (*ibanorum, ingeri, leporinus* and '*kuhlii'*), as well as *Fejervarya cancrivora* (a frog species of cultivated areas) and *Hoplobatrachus rugulosus* (an exotic frog species). These species can attain a size of 10 cm or more and, though valued by local people, are not sold. Under the correct lunar conditions *L. leporinus* is said to aggregate in the river where they are easily collected by cast net (*jala*). Other frog species are used as fish bait. Although *Bufo sumatranus* (*'jau'i'*, also known as *B. juxasper*) is occasionally eaten, toads are generally known to be poisonous and not used .

Among snakes and lizards, only pythons and water monitors are regularly eaten. All turtles are eaten and their eggs are also collected for food. Turtle nesting sites are generally well known. Turtles are also traded, with red-listed *Heosemys spenosa* (spiny hill turtle), being offered for sale to the expedition for Rp. 50 000.

Most local people are afraid of snakes, even small ones, and any snake encountered is killed or avoided. The poisonous *Tropidolaemus wagleri, Ophiophagus hannah, Bungarus flaviceps* and *Naja sumatrana* represent a genuine danger. *Ophiophagus hannah, B. flaviceps* and *N. sumatrana* are deadly. The Punan people collect the poison of *Ophiophagus hannah* for the tips of their blowpipe darts.

The reported occurrence of an undescribed poisonous varanid is biologically interesting. People of all ethnic groups claimed that their dogs died *rapidly* after being bitten by this species. No Asian lizard has ever been proven poisonous.

The occurrence of the invasive Taiwanese frog (*Hoplobatrachus rugulosus*) needs further investigation and potentially threatens the existence of local species. According to local people, it is a recent arrival (since 1997). It was first reported in the wild in Borneo in Sabah in 1978, having escaped local cultivation. These observations suggest that the invasion proceeds at a rate of about 20 km per year. The species is already collected for food.

Although data are preliminary, observations suggest logging has limited immediate impact on the overall diversity of local amphibians and reptiles. However, amphibians are potentially sensitive to various types of interventions, as will be noted in the following sections.

Wildlife survey

The Wildlife Conservation Society (WCS Indonesia) provided CIFOR with a pre-harvesting survey of wildlife in the CIFOR-INHUTANI II study area. An earlier study by WCS in neighbouring areas (O'Brien 1998) will not be summarized here but yielded a pilot evaluation and initial species lists for the wider area. Surveys of mammal, bird, and selected invertebrate communities were conducted during September–October 1998, in three contiguous 100-ha forest cutting blocks assigned for reduced-impact logging (RIL compartment 27) and conventional logging (CNV compartments 28 and 29) and in an adjacent unlogged control (called 'control' here). A full account is provided in O'Brien and Fimbel (in press). The results will be briefly summarized. It should be emphasized that *all these results derive from areas prior to logging*.

Mammals

A total of 31 species from 10 families were identified. An additional five mammal species were observed but could not be positively identified.

The RIL and CNV sites have similar species compositions though sample sizes are limited. Similarity indices (Morista-Horn) between the three treatment sites ranged from 0.65–0.95, with the CNV and RIL sites most alike in their relative abundances of primates (0.95), but less alike in their squirrel populations (0.73).

Two species of particular conservation significance, *Macaca nemestrina* and *Lutrogale perspicillata* which were recorded in the survey area are listed as vulnerable in the *1996 IUCN Red List of Threatened Animals*.

Birds

A total of 239 bird species were recorded in the survey area and surrounding landscapes. Of these, 178 represent lowland-dependent forest birds (c. 73% of the lowland forest birds in Borneo). Families with the most recorded species included Timaliidae (18 species), Pycnonotidae (12 species), and Picidae (12 species).

Twenty-nine bird species belong to an IUCN Red Book class. One is 'endangered' (*Ciconia stormi*); six 'vulnerable' (*Argusianus argus, Carpococcyx radiceus, Lophura ignita, Rhyticeros corrugatus, Rollulus rouloul, Spizaetus nanus*); one 'data deficient' (*Batrachostomus auritus*); and 21 'near-threatened'. Nine species are Borneo endemics.

Species diversity, evenness, and richness varied little between the study compartments. Road counts of already logged areas, however, produced consistently higher values than unlogged blocks. Jaccard's similarity index indicated that the RIL and CNV sites had the most similar bird communities (S_j=0.58), while the RIL and control sites were the least similar (S_j =0.50). The Morista-Horn index for the seven hornbills observed in the study showed a similar relationship among the sites, with the CNV and control sites the most similar (0.96), while the RIL and control sites were the least similar (0.77).

Snares to catch deer and pheasants were often encountered in the forest. Select species such as hill mynahs (*Gracula religiosa*) and blue-crowned hanging parrots (*Loriculus galgulus*) were captured and caged by villagers though both of these were still found in fair numbers in the forest. The straw-headed bulbul (*Pycnonotus zeylanicus*), a popular songbird, appears to have been collected to the point of extirpation.

Invertebrates

Thirteen insect orders consisting of 79 families were collected from pitfall traps, and 16 insect orders, consisting of 168 families, collected from sweep nets. The diversity of insect species within the three sites varied little using Simpson's index, with the control being the lowest, regardless of the survey techniques employed (1-*D* ranging from 0.99–0.89). For ants, however, the control site exhibited the highest diversity (*H'* = 3.52, Shannon-Weiner index), even though only four of the 28 sampling areas occurred in the control. The CNV site was also relatively high (*H'* = 3.43), with the RIL site lowest (*H'* = 2.95). Finally, sites were rather dissimilar in their insect species composition (Jaccard and Sorenson similarity indices; values ranging from 0.26–0.46 and 0.41–0.63 respectively), with the RIL and CNV sites the most similar and the RIL and control sites the least similar, regardless of the survey technique. Ants showed even higher variability in the similarity of their species composition between the three sites (CNV and RIL sites were 0.70, while the CNV and control sites were a mere 0.01; Sorenson index).

A total of 63 butterfly species (excluding Lyceneidae and Hesperiidae families) were recorded in the RIL and CNV sites. This is equivalent to species numbers recorded during similar periods at other forest sites in Southeast Asia.

Ecological processes

Decomposition rates for leaf litter were lower in the CNV site compared to the RIL site but not significantly. Herbivore damage to seedlings was highly localized, but no difference was detected between the treatment areas.

The data presented in this wildlife study provide baseline information against which subsequent data collected from the sites after logging may be compared. While the three study sites were relatively similar in their faunal composition, some significant differences in species composition and richness were observed between the CNV, RIL, and control areas. These differences may be the result of

different site attributes. Post-logging comparisons are liable to be confounded by such differences.

Review of fauna sensitivity

Current conceptions of 'good' practice in tropical high forests are preoccupied with silvicultural practices. Yet, researchers from many disciplines of tropical biology have completed work that has potential relevance to improving forestry practices in tropical landscapes. These studies, even if they do not address forest impacts directly, often contain relevant information about life history and habitat requirements for potentially vulnerable taxa. Studies of the ecology of individual species can thus identify possible changes and vulnerabilities in feeding, ranging or other behaviour following forestry interventions, and how this affects the processes of population change. Such information can guide forestry activities, and may be of greater utility than any statement of how densities of taxa may change in any one logging study.

A literature review and synthesis was completed based upon the list of taxa already recoded by CIFOR and WCS in Malinau. The aim was to synthesize relevant ecological information on each species selected for review. This included studies published in peer-reviewed journals and 'grey' literature. Experts were also invited to contribute relevant information on the species with which they were familiar. These experts were later asked to comment upon the results of the literature assessment and to make further management suggestions. At first glance there appears to be considerable information about the wildlife of Borneo (East Kalimantan in particular). However, our review reveals areas where crucial information is lacking and thus serves as a guide to future work.

The species selected for review were chosen (a) because previous studies had documented their vulnerability to logging (i.e., insectivorous understorey birds) or (b) because of availability of literature.

Literature availability

A total of 152 vertebrate species were reviewed for this study (40 bird, 29 mammal, and 83 amphibian). There were strong biases in the amount of literature found for each vertebrate taxa. Mammals were the most strongly represented in the literature, with 60 peer-reviewed articles and 44 grey literature and secondary literature sources (average = 3.6 articles/species). Birds followed with 49 peer-reviewed articles and 33 grey literature and secondary literature sources (average 2.1 articles/species). Amphibians were far behind with a total of 15 articles (average = .2 articles/species).

Survey studies predominate in the literature. These studies are useful in determining population densities, habitat preferences, and to a limited extent, social behaviour. The results of comparative surveys in unlogged and logged areas have been used extensively to recognise species' population responses to habitat alteration. However, such studies cannot identify the particular ecological characteristics of the habitat by which relative abundance is determined.

Ecological studies of individual species are the most useful in identifying changes in feeding, ranging or other behaviour following logging, and how this may affect their population densities in logged forests. However, the representation of such studies from this region in the published literature is very low. For example, from 1998 to 2000, Indonesian fauna were the subject of less than 1% of research papers in six major ecological journals. Less than 4% of the papers published in these journals were on Southeast Asia. Moreover, many of the studies in the published literature are 'short-term', lasting from 3–6 months. Due to the variability of annual patterns in forest systems, conclusions from such studies can only be considered as tentative. This highlights the importance of grey literature in locating ecological information on Indonesian fauna. The problem is in obtaining it. Most are archived in regional offices and have limited availability.

A majority of the species reported from BRF have no literature available beyond distributional ranges, habitat associations, and qualitative diet. Even among mammals, the best-studied vertebrate group, many species have received no systematic ecological field study.

Of the 40 bird species selected for review there are relatively few whose ecology is known well. Only four species could be considered 'well-known' and 21 'moderately known' within Borneo.

A total of 29 of the 80 mammal species potentially found in the area were reviewed. Of these species the ecology of 41% can be considered 'well

known' and 38% 'moderately known'. Many of these species have a role in seed dispersal and forest regeneration.

Expert input

Twenty ecologists were invited to document relevant natural history findings on species with which they are familiar and to comment on associated forest management issues. They were able to synthesize much of the available data into usable information and to point to specific sources of information. Ten authors were contacted after a working draft of the review for review and comments. Where appropriate, their considerations have been added to the information review and to the conclusions.

Birds

For the observed species, we have general ideas of their actual diet but for most, there is no detailed information regarding diet selection that may be important for understanding causal relationships between vegetation/ environmental changes and changes in species abundance. Detailed analyses of food and environmental requirements, including foraging tactics, are also required to elucidate the questions of competition, coexistence, and displacement.

Small-bodied understorey frugivorous birds, such as flowerpeckers, occur in lesser abundances in recently logged forests. These birds feed on small fruit resources, many of which are destroyed during logging. There is almost no literature on the dietary, social, or breeding habits of flowerpeckers.

The impact of habitat change on the abundance of pheasants is poorly known, and may vary strongly amongst the different pheasant species. Although most species may be found in (selectively) logged forest, the limits of their tolerances to habitat alteration are not known.

The role of predation on bird distribution and abundance is difficult to determine. Logged forests may support higher abundances of potential nest predators and may also make some nests more visible or accessible. Observations are needed to assess natural mortality on the nests, habitat selection for nest sites, and adult recruitment.

There are several studies now on the effects of logging on bird species composition and number. There is, however, a lack of data on the long-term recovery of birds from logging and this is usually in the form of pseudo-time series, which can give misleading results due to variation in logging intensities, and to pre-logging differences.

Why birds forage in mixed flocks, and the composition of these flocks, is poorly understood. The disruption of continuous habitat elements by logging may have deleterious effects on the mobility of these flocks, and the local survival of species that depend on undisturbed flock foraging. Mixed flock data should be collected to clarify the response of different kinds of flocks (canopy, understorey) to forest fragmentation and degradation. There must be foraging niche partitioning in mixed flocks to reduce intra-flock foraging competition. When habitat is disturbed, the food resource must shift and this must change competition dynamics within a flock. This may increase intraflock foraging competition and lead to a reduction in numbers of some species, and an increase in numbers in others.

Mammals

Primates

The findings from most studies of primate populations in disturbed habitats are that some species thrive while others do not. The most important factor affecting a species' persistence is an ability to change the relative proportions of different food types in the diet, specifically to exploit available new leaves in the absence of fruit. Highly specialized frugivores are less able to do this. The most successful species are those which can survive on a largely folivorous diet, even if they are behaviourally frugivorous in primary forest.

Behavioural changes following logging can lead to quite complex alterations in social organization. One study of banded leaf monkeys has shown that smaller and more evenly dispersed food sources lead to groups splitting into smaller foraging subunits following logging. Leaf monkeys also abandoned territoriality.

Territorial species typically avoid moving away from their former ranges even while logging is occurring. Abandonment of territories occurs only where food resources are critically depleted. Highly territorial animals such as gibbons may remain within their former ranges even following forest clearance or fires that destroy a high proportion of trees.

Squirrels

It is usual in tropical rainforests for a large number of diurnal squirrels to live sympatrically. In the dipterocarp forests of Borneo, segregation is seen when fruit is abundant, but this peak fruit crop is not predictable and can be exploited by species able to persist on alternative foods for most of the year. At times of low fruit availability, high dietary overlap occurs, with all species feeding on a few common fruiting trees and alternative foods.

Reported responses of squirrels to logging in Peninsular Malaysia do not follow clear patterns. Terrestrial squirrels seem least able to adapt to conditions in logged forests. This can probably be attributed to changes in food abundance and competition with other taxa, but data is limited.

Southeast Asian flying squirrels of the genus *Petaurista,* despite being naturally frugivorous, are able to incorporate leaf material into their diet at times of fruit shortage and this assists their persistence in logged forests. Densities are said to decline in older logged forests, suggesting an alternative limiting factor, such as availability of daytime refuges or increased predation.

Civets

Civets form a highly diverse and prominent group of carnivores, with both terrestrial and arboreal species. Some civets feed exclusively on sugar-rich and soft-pulped fruit. A decline in civet density has been observed in logged forests in Sabah. Predominantly carnivorous species, mainly feeding on invertebrates, were reduced to a greater extent than palm civets, which incorporate larger quantities of fruit into their diet. In contrast, increases after logging have been documented in Peninsular Malaysia.

Forest ungulates

The genera *Tragulus* and *Muntiacus* are small, forest-dwelling deer. They are among the least studied of ungulates. Until 1992 no field studies had been carried out on any *Tragulus* species (mouse deer), and in the case of *Muntiacus*, no field studies had been completed in Southeast Asia (two were carried out in South Asia). *Tragulus* and *Muntiacus* appear to be more common in logged forests than in mature forests in Peninsular Malaysia. Densities tended to decrease again in older logged forests. However, in Sabah, mouse deer occurred in reduced densities in logged forests, while densities of yellow and common muntjac did not differ significantly between forest types. Fallen fruit forms a significant proportion of their diet.

Mammal research suggestions

Small mammals are important prey for predators. This importance as a prey base argues for long-term research and monitoring of small-mammal populations and communities in a number of habitats throughout the ecosystem. This should include in-depth research on population dynamics, habitat use, community structure and ecosystem influences, including the effects of habitat disturbance and fragmentation. Such population and community studies should be conducted in concert with long-term studies of the entire predator guild. Only in this way can competitive relationships among predators be fully understood.

The role of mammals in seed dispersal and seed predation needs to be examined in detail. Taxa likely to be of particular interest are civets, bats, mouse deer, primates, squirrels, and mice.

An investigation of the role of bearded pigs in forest ecology is also justified. Bearded pigs are known to be major seed predators. Loss of dipterocarp seeds due to logging would result in pigs feeding more on the seeds of other plants, affecting seedling survival and subsequent regeneration. Also, pigs may feed more heavily on the remaining dipterocarp seeds produced after removal of dipterocarps during logging. With fewer trees, fewer dipterocarp seeds would be produced during mast years and the strategy of satiation would be ineffective. Pigs would consequently eat a larger percentage of the dipterocarp seeds produced, limiting regeneration. Exclosure studies could effectively investigate this question.

Amphibians

Anurans are probably the principal terrestrial insectivores in tropical rain forests and yet the ecology of this component of the rainforest has been dealt with in only a relatively few published studies. It is important to examine the ecology of the different anuran life stages separately, in order to assess the effects of habitat disturbance.

Amongst the 83 species of frogs identified at Bulungan, two assemblages are readily differentiated, with little overlap in species

composition: riparian and non-riparian. Forty-one species are associated with streamside environments, 39 do not breed in, or spend their adult life near streams, and three species are incompletely known. Not all 41 species of the riparian environment are wholly restricted to this zone (Inger personal communication). One, *Pseudobufo subasper*, is aquatic. Seventeen species breed and feed along streams and are thus fully restricted to this environment. An additional 22 species breed in streams or in rock pools at the sides of streams, but spread widely through the forest and apparently spend their post-metamorphic stage and much of the remainder of their lives away from flowing water. The last species, *Barbourula kalimantanensis,* is found along stream banks, but its exact breeding site is unknown. Among the non-riparian frogs, 31 species require pools or ponds to lay their eggs. Four species require treeholes and three require swamps or seepages. Only *Philautus mjobergi* lays its eggs directly on the forest floor, omitting an aquatic larval stage.

There is little specialization in the diets of frogs. The entire group feeds mainly on abundant non-aquatic invertebrates and overlap between diets is extensive, though there is some evidence of species specialization. There may be a slight correlation between the size of the frog and the size of the prey consumed.

Terrestrial frogs require either treeholes that fill with water or isolated pools in shallow depressions on the ground or potholes in rock outcrops. Riparian species of tadpoles are not uniformly distributed among stream habitats. Stream width and gradient have been found to have the most significant effect upon variation between frog communities, and

Bornean tadpoles appear to partition habitat and food. There are indications of stability in species composition within sites over time. Three factors seem to be involved:

1. Sites of oviposition determine the range of possible habitats in which tadpoles of a particular species may be found. One distinction is whether females may oviposit in streams or in the forest, at some distance from a stream.
2. Tadpoles are specialized for the physical structure and environmental conditions of the habitats in which they live. The larval *Ansonia albomaculata* have streamlined bodies and expanded suctorial lips, and larval *Amplops* have abdominal suckers enabling them to cling to rocks and maintain position in strong currents. Probably none of these suctorial devices function well in the silty substrates that might occur as a result of the higher runoff documented in forests after logging, possibly limiting occurrence of these larval species in disturbed environments.
3. Five main feeding types are recognised among tadpoles in Malinau: obligate benthic, generalist macrophagous, midwater suspension feeding, and particulate surface film feeding.

Research suggestions

At least one study (Inger 1980) has found that in Southeast Asia hotter, drier forests support fewer arboreal and terrestrial frogs, fewer diurnal arboreal lizards, but more terrestrial lizards than lowland primary rainforests. A literature search failed to locate even one publication that specifically looked at the effects of logging on the ecology and population dynamics of amphibian populations. An investigation of amphibian and lizard populations and their ecology and abundances in logged and unlogged forests in the Malinau area would be helpful.

Logging practices influence change in the relative abundance and species number of phytophagous insects, leading to changes in insectivorous predators. These need to be explored.

Conclusion

What we have summarized and illustrated is the 'baseline data' developed under our ITTO contract. However, it is more than a collection of data; it is, rather, a foundation for future work and recommendations.

We are currently developing and checking data to allow these implications to be made more explicit. Examples of more obvious win-win opportunities include the protection of sago and other forest values in RIL, the prevention of understorey slashing, and the identification of protected areas that can be respected by all major stakeholders (grave sites, birds' nest caves, springs). These data serve as a basis for future research and for evaluating trends over time.

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6. People's Dependencies on Forests

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Introduction

Diversity and change

It is widely accepted that forest people in remote areas such as Bulungan are highly dependent on forests and on forest products for their livelihood and even for their survival. The district of Malinau in East Kalimantan where the Bulungan Research Forest is located presents one of the largest remaining lowland dipterocarp forests in Asia. It also hosts various Dayak ethnic groups and one of the largest remaining populations of hunter-gatherers in Asia: the Punan. In the past, both groups totally depended on the forest for their subsistence. The Dayak are generally considered as agriculturists, practicing swidden cultivation of upland rice, while the Punan are generally considered to be predominantly nomadic hunter-gatherers. This distinction is convenient but does not stand up to in-depth analysis. Some Dayak ethnic groups do not differ much from the Punan, and over time some groups opt temporarily for hunting and gathering before reverting to swidden cultivation. Nowadays, the line between swidden agriculturists and hunter-gatherers is even more blurred (King 1993; Cleary and Eaton 1992). Most Dayak collect forest products during slack periods in the agricultural timetable, while most Punan open swiddens on a regular basis. Again, a head of household can practice hunting-gathering during an early part of his life cycle and later opt for swidden cultivation. Furthermore, some heads of households no longer either own swiddens or collect forest products.

The forest remains of paramount importance to the entire local population. Any Dayak or Punan will be able to name dozens of species of plants and of animals of economic importance to them (Puri 2001). Forest products provide subsistence goods (staple food, vegetables, fruit, game and fish), cash income (eaglewood, bezoar stones, rattan, resins and gums) and building materials and medicinal plants. The forest as a whole is also essential to the sustainability of the swidden agriculture cycle. After one to two years of rice cropping, the swiddens are turned into a bush fallow for 10 to 20 years before being slashed and burnt again. The shading provided by the trees helps the farmer to get rid of grassy weeds, while the slashing and burning provides free and abundant fertilizer. Without quick and vigorous forest regrowth, the swiddens would turn into grasslands, which have little economic value given the techniques and means locally available (Levang *et.al* 1997).

Considering the acknowledged importance of forests to local people, one can easily imagine that the Dayak and Punan would suffer most from deforestation. The loss of access to forests and forest resources would jeopardize their livelihood, force them to quit their traditional way of life and push them into utter destitution. Logically, forest people should be hardline conservationists. It does not take long while wandering around Bulungan to become convinced that they are not! It quickly appears that people only complain about deforestation by concessionaires as long as they do not get adequate compensation, and that 'investors' are welcomed all over the Bulungan Research Forest and beyond

Sago is no longer the main staple but it still serves as a safety net in time of crisis

(Obidzinski *et al*. 2001). Even remote villages of hunter-gatherers send emissaries to Tarakan in order to promote their forests to outside 'investors'.

This apparent contradiction gives rise to many questions. Has local people's dependency on forest products been overstated? Do some depend more than others on forest products? Is hunting-gathering a deliberate choice or the only available option? Are people considering other options for themselves or for their children? Who is taking advantage of ongoing changes? Who will be on the losing side?

Study sites

The Forests Products and People programme sought to understand the nature of the dependency of local communities on forests and particularly on non-timber forest products (NTFPs). The overall objective was to elucidate policies that would lead to more secure and sustainable livelihoods for these people. The impact of changing policies and external threats and opportunities for forest dependent peoples was given particular attention. Surveys focused mainly on the Bulungan Research Forest area but work extended into adjacent areas when this contributed to the understanding of issues. Most of the research was conducted in villages and hamlets in the Malinau and Tubu watershed. As the Long Loreh area had already been intensively studied by other CIFOR teams, and in order to avoid research fatigue, we gave priority to more remote upstream villages. These villages were also assumed to be more forest dependent.

When necessary, complementary surveys were carried out outside the area, as far as Malinau, Tarakan and Tanjung Selor. Work in these areas gave insights on forest dependence in areas which were more open to outside influence and contributed to a better understanding of future developments. Some comparative studies were launched in other districts of East Kalimantan, for instance in Berau, Kutai and Pasir.

Methods

While the overall objective — to assess the importance of the forest and of forest products to local people — is rather similar to that of the previous chapter, the viewpoint and methodology differ considerably. In the previous chapter, multidisciplinary methods were employed across the landscape in order to quantify and organize local values regarding fauna and flora into a hierarchy that could help guide management decisions. In this

chapter, the stress is put on forest products of economic importance to local people. The FPP team privileged ethnographic in-depth methods. Interviews with stakeholders were conducted using standard anthropological survey techniques such as closed, semi-open and open questionnaires. In some specific cases, the interpersonal skills of the consultant allowed the collection of fairly complete and precise data, especially from eaglewood traders and fishermen[1].

For household surveys we used a semi-open questionnaire, given to randomised samples of 30 families in the larger villages and exhaustive samples in villages with less than 30 households. The questions asked concerned family data, farming system characteristics, forest product collection, off-farm activities, and incomes and main expenditures. A more open part of the questionnaire inquired about biodata, perceptions and expectations of the head of household and of his wife. In a first stage, the household survey focused on five villages located along an upstream-downstream gradient in order to account for differences in access to forest resources, access to markets and ethnic diversity. The villages chosen were Long Jalan (a Punan community in the upper reaches of the Malinau River); further downstream, Tanjung Nanga (a Kenyah community with some Punan families) and Langap (an ancient Merap village); and in the lower reaches of the Malinau River, Pulau Sapi (a Lundayeh village which recently became the capital of the Mentarang Baru subdistrict) and Respen Sembuak (a resettlement village regrouping eight Punan villages, one Merap and one Abai village which were relocated in the early 1970s from the Tubu watershed). In the second stage, we focused more on the Punan hunter-gatherer villages and hamlets still remaining in the middle and upper Tubu. The comparison between these villages and the resettled ones in Respen Sembuak provide the most valuable information about the trade-offs and pay-offs linked to resettlement and to a reduction in dependency on forests and forest products. All household surveys were complemented by the collection of anthropological data.

The survey of marketing of forest products used a trading chain approach. The forest product was traced from its collection by hunter-gatherers, its buying and reselling by local traders through to wholesalers and exporters. The survey on the impacts of concessionaires on local people and the survey of wood utilization were carried out with the assistance of the major concessionaires in the study area: INHUTANI I and II, BDMS and the mining company John Holland.

Anthropological data was collected through non-directive interviews of local people, with special attention given to village elders (men and women), heads of villages and *adat* and community leaders. Special emphasis was given to exchanges[2] among family members, neighbours and communities, to cultural aspects of economic activities, and to perceptions, wishes and visions of the future. Formal education and healthcare were given special attention as these two items emerged as the most important for local communities. Local government officials, religious leaders, teachers and development workers were often among the most relevant informants.

Results

1. Dependency on forest products for subsistence needs

The highest level of dependency on forest products for subsistence needs is found in the Punan villages of the upper Tubu. It takes four to five days by boat to reach Long Pada from Malinau. Because of the many rapids, only small boats can be used. Long-tail engines are preferred to outboard engines because the latter's propellers are too expensive. After heavy rains the rapids become too dangerous to pass and the boatmen prefer to wait for the water level to fall again. To pass some rapids the boats need to be unloaded first and then hauled through. The two villages upstream from Long Pada, Long Ranau and Long Nyau, can only be reached on foot via narrow and difficult paths.

Each village hosts about 20 families, all related to each other. Their way of life is still very traditional. Nearly all families open a swidden in primary or secondary forests once a year[3]. All work is carried out on a mutual aid basis by households organized in small neighbourhood groups (Issoufaly 2000). Agricultural activities are mainly limited to upland rice and cassava cultivation. Other crops like coffee, sugarcane, eggplants, cucumbers, peppers, etc. can be found in gardens close to the village but always in small numbers. Only very few households own orchards, generally in former settlement locations.

Fishing provides additional proteins...

In 2000–2001, the average size of a swidden was 1.4 ha and the average yield, 697 kg of paddy per ha. Only 34% of the households covered their staple food needs from the production of their swidden. On average, upland rice cultivation as locally practiced only requires 61 man-days per ha, which implies a rather high return to the man-day i.e. Rp. 15 500 per man-day. Hence, there is also plenty of time available for other activities.

The activity most favoured by men is wild boar[4] hunting. Every fit male aged 16 to 40 goes wild boar hunting on average three times a week. The hunt is organized on an individual or a very small group basis, generally two to three men with spears and three to six dogs. The hunt starts early in the morning and may last until mid-afternoon. The preference for bearded pig is due to its high fat content. In the upper Tubu, pig fat is generally the only source of fat in the diet. Roasted fat is also a feast for the gourmet. Catching anything other than a bearded pig is considered as being tantamount to returning empty-handed. For instance, hunters who catch a barking or a samba deer early in the morning kill it and abandon it in the forest. If they end up empty-handed in the afternoon they will come back to their prey and only take home the hindquarters and the antlers of the deer. Blowpipe hunting is a lonely activity reserved for specialists. Any living creature[5] in the forest becomes a target: birds, reptiles, monkeys and even bearded pig. Different species of plants are used to prepare poison[6] for blowpipe hunting. The hunted animals are always shared among all families in the settlement. Even short-term visitors are entitled to a share. Outstanding hunters enjoy prestige and are widely reputed.

Fish is plentiful in the rivers and their tributaries. Angling, cast-net fishing and trapping are frequent. Most people fish on average once a week (Mannes 2001). Still, fish is considered as merely a poor substitute for bearded pig. Though the forest contains countless edible plants, the Punan avoid porterage as much as possible. Only forest products that can be eaten on the spot are considered worthwhile picking. As a consequence, the major part of the diet is provided by crops — rice, cassava tubers, cassava leaves, bananas, pineapple, etc. — and by spontaneous species from swiddens and fallows close to the village like fern crosier[7] and *terap*[8].

The forest also provides building materials and raw materials for handicrafts. Borneo ironwood[9] or other hardwoods are used in village houses and swidden shelters for stilts. Barks from many tree species and bamboos are used for floors and walls. Leaves of the *Licuala* palm and of other trees[10] are

...but bearded pig is the Punan's favourite meat

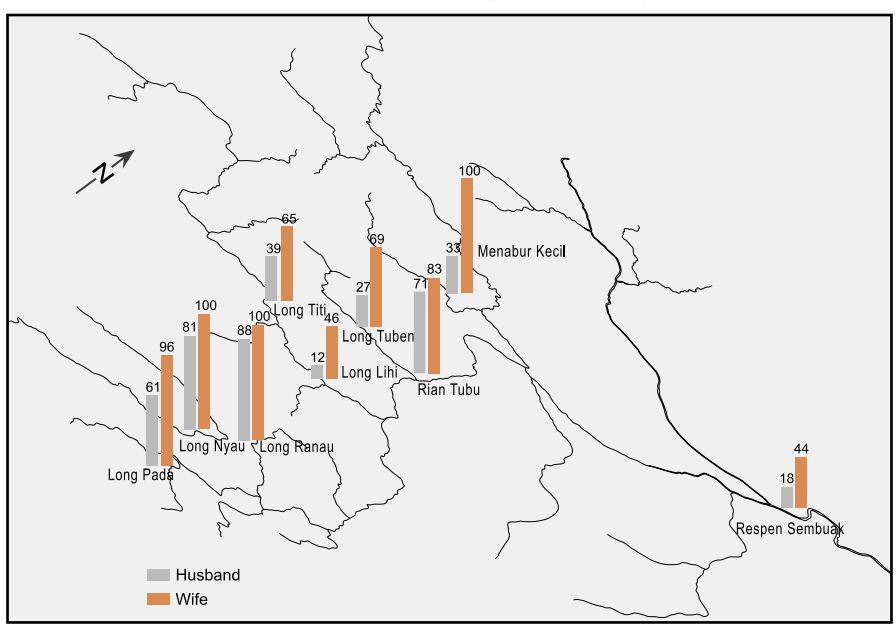
used for roofs and many species of rattan to fix all the parts of the structure together. As most of these components must be replaced frequently[11], people's preference goes to modern houses made of wooden planks with tin roofs fixed by nails. Planks and beams can be produced locally, provided that chainsaws are available. Tin roofs must be bought in Malinau and shipped to Long Pada in the upper Tubu, which doubles the cost. Porterage to Long Nyau or Long Ranau would double the cost once again. This is why only one household in Long Nyau could afford a tin roof.

Countless medicinal products of vegetal or animal origin have been recorded from the area. Information on how to use and prepare them still needs more research, as shamans are rather reluctant to give away their secrets. Shamans generally treat specific diseases, such as possession by spirits and mental disorders, but also fractures (Boedhihartono 2000). More common diseases like malaria, influenza and diarrhoea are considered as originating from downstream and as such must be treated by downstream medicine. Punan hunter-gatherers are large consumers of aspirin and paracetamol. Fever is still the main cause of child mortality and in the upper Tubu, in Long Pada, for instance, 46 children out of 100 die before the age of five.

The forest plays an important safety net role. Only one household out of three enjoys sufficient rice production to cover the family's annual needs. All others depend exclusively on cassava tubers once the rice is exhausted. One to two months before the next upland rice harvest, most families experience a food shortage. This is the period of the *mufut*, when all families leave the villages for a whole month or more (Kaskija 2000). Reviving ancient traditions, small bands of five to ten families live under tarpaulins and roam the forest looking for sago[12], game, vegetables and fruit.

There is no doubt that in remote areas like those in the upper Tubu, people are still totally dependent on the forest for their livelihood. Sago is still a staple food for the poorest families, at least during part of the year. Living in the upper Tubu has drawbacks and advantages. In the early 1970s, when a move to Respen Sembuak, the resettlement community close to Malinau, was proposed, the three villages of the upper Tubu refused to move. The main reason for their refusal was that they did not want to 'split up with the meat'[13]. It was a free choice but also a no-return choice. By opting for bearded pig, they were unable to participate in the general evolution of the province. Having little access to education and healthcare, today they are probably the most marginalized of all communities of Kalimantan. Figures 6.1 and 6.3 compare mortality and illiteracy rates between Respen Sembuak and the villages in the upper Tubu.

Figure 6.1 Illiteracy rates in the upper Tubu (in percentage)



2. Dependency on forest products for cash income

The forest provides countless products for forest people. However, only very few have a market value. The marketing of Borneo's forest products dates back many centuries. Most coastal towns of Borneo were founded by traders in order to capture the benefits of forest products, especially birds' nests for the Chinese market (Sellato 2000). Through history, many forest products had their hour of glory. Some, like Borneo camphor, *damar* resin, numerous gums and rattans, are no longer traded. Others, such as wild honey and bezoar stones, enjoy good sales but are too rare to make a living from. For the time being in Bulungan, apart from timber, swifts' nests[14] and eaglewood[15] are the only forest products that can provide a regular livelihood to collectors (Katz 1997).

Birds' nests are collected in caves, which are privately owned by the finder or his heirs. Nowadays it is rare but still possible to discover productive caves. In the villages surveyed, a handful of households had managed to find new productive caves. However, most productive caves in Bulungan have been known and managed for centuries. Gaining control over caves was even one of the main triggers for migrations and warfare in former times. In Langap for instance, two extended families subdivided into eight households control two caves producing high-grade birds' nests. Each household earns about Rp. 12 million yearly from this activity.

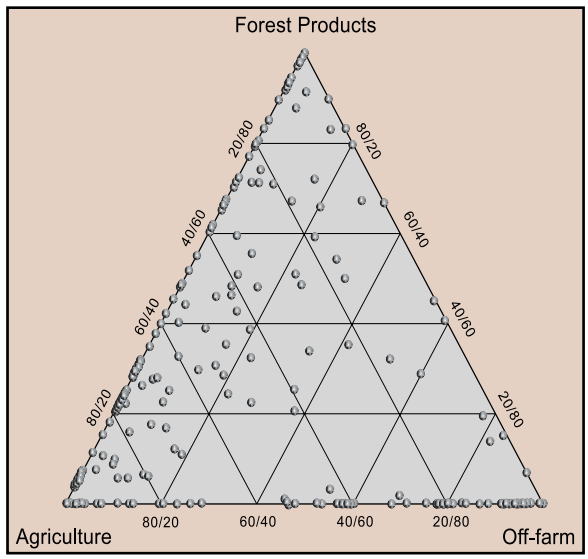
Eaglewood is the only forest product a collector can depend upon in order to make a living. Because of the high demand, the resource is being depleted in most areas. Eaglewood is still available in remote forests in the upper reaches of the rivers. Punan villages try to control access to the resource and ask for collecting fees from outsiders. The latter are generally reluctant to pay the fees and try to avoid coming too close to the Punan settlements.

In the villages of the upper Malinau, Long Uli, Long Metut, Liu Mutai and Long Jalan, nearly all households are totally dependant on eaglewood for their livelihood. Collecting tours are organized all year round, with short pauses only during the slashing of the swidden and upland rice harvesting periods. Gathering activities clearly prevail over agricultural activities. In Long Jalan, for instance, swiddens are rather small, not very well kept, fallow times are short and yields very low. One household out of four did not even bother to open a swidden in 2000. As a consequence, the production of upland rice does not cover the families' needs. In Long Jalan, collecting sago for food is tantamount to a loss of face. People prefer to buy their rice. This is a deliberate choice, as they consider it easier to buy rice with the money from eaglewood gathering rather than producing their staple food themselves. Thus, most households depend on eaglewood collection to secure their cash and subsistence needs (Figure 6.2).

Heads of households and male teenagers generally leave the village for a three-week period to search for eaglewood[16]. Punan collectors are organized in small groups of three to seven people, rarely more. They bring along their dogs, spears and blowpipes for hunting. The group has some basic cooking utensils and a tarpaulin, and each individual takes 10 kg of rice together with salt, cigarettes and medicine. All these items are generally provided on

Eaglewood (gaharu) is the main source of cash for Punan hunter gatherers

Figure 6.2 Bulungan household survey: origin of income



credit by the trader. The latter also provides credit to the families of the collectors remaining in the village. During the collecting, the group moves its camp from time to time depending on the availability of eaglewood. Cooperation amidst the group is restricted to security matters, hunting and cooking. The actual gathering for cash is always an individual activity; the harvest belongs to the finder and is never shared among the group.

After three weeks the group heads back to the village with finds worth Rp. 300 000 to Rp. 600 000 on average. Less experienced gatherers may go home empty-handed, while lucky ones may hit the jackpot. Finds of up to Rp. 30 million or more are recorded at least once a year. Such lucky finds contribute to maintaining the high motivation among the collectors. But on average, once debts are repaid to the trader, it does not take long for the collector to exhaust his pay in basic commodities (rice, sugar, salt, coffee, noodles, cooking oil, cigarettes, alcoholic drinks, medicine and clothes). Even bigger finds are exhausted in a few days on a single trip to the district capital to buy consumption goods such as televisions, generators, VCDs, chainsaws and long-tail engines. After a week's rest in the village, purchased food stocks and cash come to an end. The family quickly reaches its lending limit at the local store and soon the pressure on the collector becomes unbearable. A new expedition to the forest becomes unavoidable.

Eaglewood gathering for cash is not restricted to upstream Punan villages. Other ethnic groups like the Lundayeh, Abai, Merap, Kenyah and even outsiders from Java and Lombok also collect eaglewood. But unlike the Punan, most Dayak groups consider eaglewood collection only as a secondary activity (to agriculture) or an alternative source of income. However, when cocoa and coffee plantations along the Malinau were destroyed by the great floods of February 1999, eaglewood collection regained ground.

In downstream Dayak villages and in resettled Punan villages, eaglewood collecting is limited to one or at most two trips a year during slack periods for agriculture. Collectors are generally young heads of households or young male adults. As the resource is already depleted in nearby forests, they have to forage in forests generally claimed by upstream Punan villages. Collecting parties often consist of 10 to 20 people in order to cope with this increased risk and to avoid paying the fees provided for by customary law. Less experienced than the Punan, these occasional collectors make small finds (on average less than Rp. 300 000 per trip) but they do more damage to the resource[17].

Apart from eaglewood and birds' nests, some other forest products like rattan and game have market potential. The rattan trade came to a complete stop in the area when the commodity price plummeted in the late 1990s. Prices dropped from Rp. 5000/kg wet before the crisis to Rp. 3000/kg after the crisis in current rupiah (or to one seventh of its value in real terms). Pak Abu Bakar, the last trader to attempt to buy rattan, went bankrupt. However, locally rattan is still the basic material for wickerwork. Rattan baskets (*anjat*) and mats (*tikar*) are essential utensils for everyday life. They also play an important cultural role, as they form part of the goods exchanged between families (*sulang*) for a marriage (Césard 2001). Punan women are renowned for their ability in wickerwork and the recent influx of outsiders (concessionaires, scientists and tourists) provided a new market for handicrafts. In villages close to markets handicrafts play an important economic role, as it is generally the only opportunity for women to raise cash.

Game, in particular venison, can easily be sold on the Malinau market. However, a strong Bugis connection prevents Punan hunters from selling game on the market, arguing that the animals were not killed in a *halal* way[18] (Kurniawan 2001). If not brought to the market alive, the meat has to be sold off at

discount prices. Some informants contend that the buyer often later resells the meat at *halal* prices. Lately, direct selling of bearded pig to Chinese traders or to Respen Sembuak dwellers has been recorded.

3. Dependency on markets

Most forest products are only used for subsistence because they cannot be sold. This does not imply that there is no market for those products, but rather that there is little demand for these products on the local market or that potential markets are not accessible. This lack of accessibility can be physical (distance, absence of roads and means of transportation), financial (cost of extraction, shipping, selling price), socio-economic (limited demand, trading barriers, taxation, trade restrictions) or cultural (inappropriate product not appreciated by consumers) and more often a combination of all these factors.

However, such conditions are not immutable. Timber, for instance, is an invaluable forest product, with very little value in the upper Tubu as long as no road allows its exploitation. This is very likely to change in the near future. Agricultural products like coffee or fruits produced in the upper reaches of the watersheds cannot be sold to Malinau as long as transportation costs exceed average selling prices. Again, this is likely to change in the future with the opening of new roads and the increase in demand due to the development of the district's capital. The inland fishery sector in Malinau is a perfect illustration of what may happen with other forest products in response to increased local demand.

In the upper Malinau watershed, local people mainly catch fish for subsistence needs. The resource is very abundant in villages like Metut and Paya Seturan, and present market limitations prevent fish from becoming an alternative source of income for the local population. The only market centre of Malinau town is located more than two days by boat from Metut.

Closer to the town of Malinau, the high urban demand for fish and shrimp provides local people with an attractive alternative source of income. Shrimp fishing has become the favourite activity of many households[19] because of the relatively high prices for local freshwater shrimp (Rp. 22 000 to 25 000/kg). Two techniques are widely used: nets and electric gear. The use of electric gear, though illegal, is tolerated as long as the more 'modern' fishermen do not penetrate the territories of the more 'traditional' ones. According to the techniques used and to the available fishing days, a shrimp fisher can earn on average as much as Rp. 900 000–Rp. 3 000 000 per month. The specialization level is high as 66% to 78% of the total family income is attributable to shrimp fishing (Mannes 2001).

As far upstream as Paya Seturan, river water quality suffers from the negative impacts of logging and mining concessions. Apart from the heavy pollution caused by logging activities and the spillage of mining residues, concession workers are blamed for their intensive use of pesticides and electric gear for commercial fishing. River pollution by concessionaires, overexploitation of river resources and use of unsustainable fishing techniques has triggered many conflicts about water and aquatic resources. Local people claim high compensation from concessionaires and fight each other for control of aquatic resources. The rapid emergence of an urban market in Malinau prompted the use of unsustainable fishing techniques and a strong decrease in the availability of the resource. Moreover, ethnic divides further aggravate already harsh conflicts over the resource.

Such excesses are likely to happen with many other forest products as soon as roads open up the remotest forest areas of the district. However, it would be a mistake to lay the blame on outsiders alone. In the first phase, outsiders are generally better-equipped to take the lead in the business. They have better access to the developing market and generally master more efficient, 'modern' techniques like dynamite, electric or pesticide fishing, night hunting with four-wheel drive cars and shotguns, logging with chainsaws, etc. In the second phase, local people quickly adopt the new techniques[20] and extend them to larger areas. Chainsaws, shotguns and pesticides are items already familiar to local people. For the last 20 years, chainsaws have been the inevitable souvenir for migrants to bring back from Malaysia. Chainsaws even became the usual gift to be included in bride prices.

One starts to wonder if sustainable techniques are reserved for subsistence goods only. As soon as marketing opportunities appear, outsiders as well as local people make a rush on the resource and try to get the most out of it as quickly as possible.

Sustainable ways of exploiting forest products for cash have yet to be found.

4. Dependency on traders rather than on markets

In the upper Malinau, the Punan are as dependent on forest products as in the upper Tubu. However, while the latter depend on forest products for their subsistence needs, the former depend on eaglewood for their cash income, which in turn they use to buy their food. This difference is neither linked to resource abundance nor to cultural preferences but to the level of trading activities. In the upper Tubu although the resource is far from being depleted only very few traders dare to risk their boats on a four-day journey across dangerous rapids. The upper Malinau is easier to reach and four traders[21] compete on a regular basis for the resource.

Trading in forest products is a textbook case of a patron-client relationship. According to a well-off trader, there are three main keys to success in forest product marketing: (1) prompting people to collect, (2) securing the collectors' loyalty and (3) getting the best out of the transaction (Kurniawan 2001).

In order to incite people to collect products in the forest for three weeks in uncomfortable and unhealthy conditions[22] , indebtedness to the trader is the preferred option. Keeping people indebted is good leverage to foster the collecting spirit and to ensure loyalty. As the first step, traders take advantage of the hunter-gatherers' consumerist tendencies. They supply them both with basic necessities and expensive manufactured goods on a credit basis. Quite often, traders make bigger benefits on the manufactured goods they sell than on the eaglewood they buy. The traditional bride price the groom has to pay to his in-laws also serves the traders' objectives. In former times, exchanges were limited to prestigious goods like Chinese jars and gongs, which could be kept from generation to generation. Nowadays, the most sought-after goods, such as long-tail engines and chainsaws, are not only expensive but also need frequent replacement (César 2001).

Once hooked, the client has no other choice but to collect forest products for his patron. In order to finance a two to three-week collecting tour to the forest, the collector usually takes another loan[23] of Rp. 100 000–300 000 from the trader. Later, this loan is deducted from the amount paid to the collector. Quite often the value of the eaglewood sold is insufficient to cover the credit and debts accrue. Most collectors are trapped in debt and are thus obliged to sell their forest products to a specific trader. Such a rule also applies to traders. Those who work with their own capital are free to sell their eaglewood to any wholesaler. Traders working with capital borrowed from a *toke* (wholesaler) are of course obliged to sell their produce to that *toke* (Kurniawan 2001).

Every trader has strong ties with his collectors or *anak buah* and takes all necessary steps to avoid competition with other traders. Securing the loyalty of one's *anak buah* is an absolute necessity. Debt is not always sufficient. To prevent the collector from selling his product to the first trader he comes across, the most efficient way is to make sure to be that trader. Thus, after organizing a collecting tour, traders often stay in the villages and wait for their *anak buah* to return. Adopting local customs and being able to speak the local language are also essential to secure loyalty (Kurniawan 2001).

Most eaglewood traders are outsiders. Very few traders are Punan and they only work on a very small scale (four to five *anak buah*). One trader, Haji Mahfud, controls, directly or indirectly, about 70% of the eaglewood traders of the Malinau watershed. Most traders have family links with him and borrow funds from him. Confidence and trust clearly depend on family links and/or on ethnicity. Thus, there is a strong tendency for traders to marry indigenous women in order to strengthen the relationship with their *anak buah*.

Getting the best out of the transaction is secured by strong dependency ties, by the opaqueness of the market, and by certain level of deception. Being considerably in debt to the trader, the collectors' bargaining power is limited. They generally have to accept the grade and the price decided by the trader. Traders, however, must be careful, because if they go too far they will lose their *anak buah*'s confidence and loyalty. Collectors might well sell their harvest to better-paying traders and never repay their debts.

In marked contrast to agricultural or timber products, the market information regarding demand, supply and price trends for NTFPs is very poor. The problem of non-availability of basic information on actual production, local consumption, and the surplus available for domestic and international trade is very

acute. At national level, except for a handful of very important forest products like rattan, bamboo, oleoresin, etc., very little knowledge exists and most NTFPs are rarely covered in national statistics. Eaglewood marketing is typical in that it suffers from a total lack of transparency. The traders are the collectors' only source of information. From our enquiries, no gatherer had the slightest idea on the use, the users or the final destination of the product he was collecting, not to mention the price levels reached at the other end of the trading chain. The local traders' knowledge was also limited to the wholesalers' level.

Eaglewood purchasing is allegedly based on quality. The quality depends on contents in the resin, its form and general appearance. High quality eaglewood is black and sticky. Thus, colour is the main criteria of quality. The darker the wood, the higher the price. Eaglewood quality appraisal is very subjective, with buyers and sellers using different colour charts. Of course, every trader tends to downgrade the quality of the eaglewood he purchases. Prices also vary greatly from one trader to another whatever the quality. Traders generally tend to pay higher prices for small quantities of higher-grade eaglewood, and to pay less for larger amounts of lower-grade eaglewood. Needless to say, collectors are usually on the losing side.

However, in patron-client relationships deception is always limited to acceptable levels. Exaggeration would cause the breaking of the tie, throw the collector into another trader's arms, or prompt him to renounce collecting and/or disappear in the forest.

The total lack of transparency of the market and the absence of recognized standards of quality at local and national level are the main causes of the failure of the marketing chain. As a consequence, the nominal value of eaglewood is not based on an interaction between supply and demand, and no fair market mechanisms are available.

5. Dependency on forests for swidden cultivation

The former differentiation between Punan hunter-gatherers and Dayak swidden cultivators no longer applies in Bulungan. Nowadays, all communities — with only few exceptions — have adopted rice as their staple food and practice upland rice cultivation. In recent years, some communities have even expressed an increasing interest in lowland rice cultivation.

The adoption of swidden cultivation by the Punan is concomitant to the settling in villages and to the changing of staple from sago to rice. For some Punan groups this change occurred two to three generations ago, whereas for others it is contemporary. Nevertheless, there are great differences between Dayak and Punan methods of managing a swidden. Though techniques are rather similar, this difference expresses itself in the size of the swiddens, in the number of varieties of upland rice seeds, the amount of labour used and the yields of the crop.

Swidden upland rice cultivation is perfectly suited to the specific conditions of the physical and economic environment of Borneo: very low chemical soil fertility, abundance of land and scarcity of labour. The determining factors of this farming system are the burning of the slashed biomass and the bush fallow period between two slashings. Because of rapid mineralization and heavy leaching, the very old soils of Borneo — from a geological point of view — are very poor in nutrients. In the absence of fertilizers, the slashing and the burning of the abundant biomass provides a considerable amount of nutrient in the form of ashes for the crop. A swidden that cannot be burnt is never seeded, as the crop would not be fertile. A swidden is only cultivated for one to two consecutive years, seldom more. This is because, firstly, the ashes are quickly removed[24] and the nutrients leached by the heavy rains. Secondly, once the forest is cleared, grassy weeds tend to overrun the swidden, and after two years yields drop by half if the farmer does not resort to weeding. But weeding is tedious and labour-intensive. Where land is plentiful and labour expensive, it is economically more profitable to open a new swidden than to resort to weeding. The old swidden is not abandoned but left fallow. The luxuriant forest regrowth will help the farmer to get rid of the grassy weeds by shading out without applying any labour. After 10 to 15 years or more, the regrowth turns into a secondary forest free of grassy weeds and the plot is ready to be slashed and burnt again. Short fallows of five years produce enough biomass to fertilize the swidden. However, it takes 10 to 15 years to substantially reduce the stock of grassy weeds. After 20 years of bush fallow the effect of the shading out is similar to that of a primary forest (Levang *et al.* 1997).

The system has many advantages. If practiced properly, it is ecologically sound and sustainable, it requires little labour and provides high returns per man-day. Its main drawback is that it is rather land consuming. A holding of 15 to 20 ha per family is necessary to ensure the system's sustainability. Otherwise, the length of the fallow period has to be reduced, the soil fertility level decreases, the swidden is overrun with weeds, risk of fire increases and regular burning may turn the swidden into *Imperata* grassland.

Another drawback of the system is that it provides rather small yields — compared to lowland rice — and that there is little room for yield improvement without resorting to inputs and applying more labour. On the contrary, there still is room to improve the system's already high return to labour. The introduction of chainsaws, for instance, has a tremendous impact as it reduces labour requirements for felling from 25–30 man-days to three man-days per ha. In other parts of East Kalimantan like Pasir, where land is becoming scarce, herbicides have rapidly gained popularity among swidden cultivators. Herbicides enable the shortening of the bush fallow period without resorting to manual weeding. However, in Bulungan land is still plentiful and the use of herbicides is limited to areas close to Malinau and to outsiders.

In fact, the area under swidden cultivation increased considerably in the district of Malinau during the last decade. Traditionally, swidden cultivation is restricted to areas close to the village or easily accessible by boat. As the harvest must be brought back to the village, a walking distance of two hours is generally the upper limit for opening a swidden. The limit can be extended as long as the harvest can be shipped to the village. The situation totally changed with the building of the road network from Malinau to Loreh and beyond. Thanks to the road, villagers could expand their swidden area as far as 30 km from Loreh. The transportation provided by concessionaires, not the road itself, is the determining factor. Hitch hiking from the village to the swidden and back is commonly practiced. At harvest time, farmers tip the lorry drivers to haul the rice back to the village. Recently, as part of a compensation deal for environmental damage, Loreh villagers obtained transportation facilities from mining company BDMS. Now, every morning, company trucks take commuters from Loreh to their swidden and pick them up again in the evening (Buyse 2001).[25]

Dayak swidden cultivators commuting from Long Loreh to their ladangs (farms)

In villages close to concessionaire camps, some farmers — mostly women — specialized successfully in producing vegetables for the market (Sitorus 2001). However, such opportunities are rare and more often swiddens only provide part of the household's needs in rice and in vegetables. Very few farmers are in a position to sell part of their production. The complement is bought on the market with cash obtained from non-agricultural activities like forest product gathering, part-time work for concessionaires, 'illegal' logging and other off-farm activities.

Though rather high when compared to Java for instance, returns to the person-day in the agricultural sector are lower than wages from other opportunities. Thus, heads of households often give priority to off-farm activities. Farming is at least partly restricted to providing food security for the family. The recent development of lowland rice cultivation in Bulungan is partly linked to this preference for cash-earning jobs. Though requiring rather small amounts of labour, swidden cultivation necessitates the presence of the head of household at least for the slashing and generally also for the seeding and the harvesting. In the case of lowland rice cultivation, as ploughing is not practiced locally, all the work — slashing weeds, transplanting rice seedlings, weeding and harvesting — can be done by women, thus totally freeing the men from agricultural activities[26]. Such evolution is already commonplace in Langap, Pulau Sapi and Respen Sembuak (Issoufaly 2000). But in the two latter villages, the development of lowland rice cultivation is also due to restricted access to swidden cultivation areas, which is usual in resettlement villages.

6. Dependency on concessionaires

Concessionaires such as logging companies or coal mining companies, non-governmental organizations (WWF) and research institutes (CIFOR) draw mixed reactions from local people. In a first approximation, they do not really differentiate between all these outsiders. The general perception is that if a wealthy outsider, living in a comfortable environment and benefiting from the best of development is willing to come to forest, it can only be in order to become richer. At the very least, there must be a trade-off. Thus, local people consider that they are rightfully entitled to tap part of this wealth (Sitorus 2001; Kaskija 2000).

Concessionaires, for their part, consider that they have paid for the right to extract logs or coal, and the government should not ask them to carry out local development in place of the local authorities. Until recently, a good relationship with local people was not really considered an essential asset for concessionaires. Everything changed with the *reformasi* era when it became obvious that bad relationships could end up in costly conflict.

Since then, concessionaires have been eager to demonstrate that they have a considerable impact on local people's wellbeing. They claim they have a significant direct impact on local people by offering employment opportunities, through the PMDH programme (see below), the opening of new roads and the payment of compensation for the loss of agricultural land. But their indirect impact is probably more important, through the opening of new areas for shifting cultivation, through increased marketing opportunities for local forest and agricultural products and through providing secondary employment opportunities. However, concession workers may also compete with locals for forest resources and thus foster new conflicts. Last but not least, by disrupting the traditional way of life of local communities the concessionaires often have a strong negative social impact.

Results from our research showed that direct employment opportunities with concessionaires are still very limited for local people. Though about 80% of the positions could be held by locals, data from companies[27] show that on average only 50% of the jobs are given to locally hired people. In fact, this figure includes quite a lot of outsiders who applied locally for the jobs. Limited skills and low reliability are often the main reasons why concessionaires avoid hiring local people. Local people, for their part, cite ethnic preferences and family connections to explain the discrimination (Sitorus 2001).

The PMDH programme[28] is a government initiative trying to involve concessionaires in local development projects for the benefit of local communities. INHUTANI I and II proposed the development of road infrastructure at village level, and subsidized agricultural development through the distribution of seedlings, pesticides and fertilizers, demonstration plots and agricultural extension. Unfortunately, PMDH programs are generally not very successful. Failure is mostly due to the lack of commitment on the part of the concessionaire's

personnel, the lack of involvement of local people in the process, and limited human resources and funds. Some programmes, however, had greater impact, such as the donation of a truck to a village cooperative for transportation between Loreh and Malinau.

Compensation obtained from concessionaires for the loss of agricultural land has had a tremendous economic impact on local people. Compensation in hard cash is the most popular but many concessionaires prefer to settle for compensation in kind which benefits the whole community: roads, housing, community buildings, and water supplies. Recently the main criterion of the choice to open new agricultural land has been the possibility of obtaining compensation from concessionaires.

Indirectly, the proximity of a concessionaire's activities has a determining impact on the village economy. The access to a new road network opens up new marketing opportunities, especially for timber. The economic centre of the villages often moves from the riverbanks to the roadside. The new roads open up huge areas for shifting cultivation, some farmers opening swiddens and creating plantations as far as 32 km from their village. People from Gong Solok intend to move their village from the Malinau River to the logging road. Some Punan from Long Loreh plan to create a new village along the road between km 49 and km 51. Though they already moved their village three times during the 10 last years, the inhabitants of Langap want to reconstruct their village on the other side of the river in order to benefit from a direct road access to Malinau. The people from Long Loreh obtained transportation facilities from BDMS. Every morning and evening tens of farmers wait on the roadside as commuters to be transported to and from their swidden. Concessionaires' camps are also popular spots for marketing forest and agricultural products like vegetables, fruits, game, goats, fish, birds, and handicraft products. These new marketing opportunities have helped to increase the price of agricultural products by 20% to 40%. These commodities are now the main source of income for local people.

Numerous indirect job opportunities are also linked to the presence of the concessionaires. In villages close to camps the influx of workers had a tremendous impact on the development of shops, restaurants, houses or room rentals, jobs as cooks and washerwomen and so on. The price of land in the village of Loreh increased by 400% and a small room can be rented for Rp. 30 000 to 60 000 per month.

The social impact of concessionaires has also been tremendous. By increasing economic opportunities and by opening remote villages to the market, concessionaires considerably disrupted the traditional social order. Family ties get looser and self-help is no longer popular. Everybody is looking for big and easy money. Greed is generally at the source of new conflicts with the concessionaires but also with other villages and among villagers. There is no doubt that the indirect impact of concessionaires has been much more important than their direct impact. However, concessionaires are not to be held responsible individually. The disruption of the traditional society would probably have happened anyway[29]. The concessionaires only accelerate the process by creating a conducive environment.

In a bid to improve relationships with local people, INHUTANI II considered the possibility of helping local people to exploit the waste wood from timber extraction. Our research showed that a quite considerable amount of wood usually left to rot could be reclaimed this way. However, such an operation would need considerable involvement from the logging company in matters of organization, transportation and maintenance, not to mention the legal aspect of the problem (Gumartini 2001). But the main drawback, for the time being, is the rapid development of IPPKs[30]. With the latter, villagers are offered royalties by 'investors' for the logging of so-called traditional forests. Local people no longer see why they should be content with waste wood when they can enjoy the benefits from all the timber. All over the district of Malinau, the craze for IPPKs is pushing villagers into deals with investors (Obidzinski *et al*. 2000). Huge advance payments to village heads are later deducted from royalties, and promises of conversion into plantations are generally fallacious. The lure of easy money is the main driving force. But at present rates of deforestation there will be no forest left in the Malinau district in 12 years' time.

Recently there has been an escalation in the number of claims for compensation from companies. Resorting to demonstrations and roadblocks to extort money from concessionaires has become commonplace, even for the most trivial reason[31].

People learn fast. Following Jakarta's example, some wealthier groups recently created new job opportunities hiring demonstrators by the dozen to put pressure on companies. Though many of these claims are legitimate, there is an increasing tendency to seek easy money from outsiders or from the government rather than to involve oneself in economic activities. In line with this, it seems that the forest is no longer considered as essential for making a living but rather as a source of easy money.

7. Dependency on outside goods and services

In former times, forest people bartered forest products mainly for salt, tobacco, loincloths and iron blades. Chinese jars and gongs, and to a lesser extent beads and betel chewing kits were the most sought-after prestige goods. Jars were used daily as containers but also as funeral urns. Jars served as units of value, and a family's reputation could be measured by the number of jars owned[32]. They were the most important item of the bride price (Césard 2001).

In the context of active headhunting, the survival of a small group depended on its ability to secure strong ties with other bands. Such ties were mostly based on matrimonial links and materialized by the exchange of prestigious goods like jars, gongs, blowpipes, etc. There is no doubt that the main trigger for bartering forest products[33] was the necessity of obtaining these luxury goods from the outside world. In stratified ethnic groups, the ownership of 50 jars was commonplace for an aristocratic[34] family. As exchanges were taking place among small numbers of families and over generations, wealthy families were able to accumulate prestige goods over time.

Nowadays, such accumulation is no longer possible for various reasons. First, the spectrum of prestige goods has increased considerably. Chinese jars are still sought after but have lost popularity in favour of modern manufactured goods like long-tail engines, chainsaws, motorcycles and electronic goods. These modern goods are not only costly, they are also easily damaged and need maintenance or quick replacement[35]. Second, the bride price has increased considerably. Nowadays, the bride price asked for a Punan girl from Respen is totally out of reach for a young man living in the upper Tubu. In the Putuk ethnic group, the bride price has become so excessive that many young men look for wives from other ethnic groups. Thus, prestige goods are lost to other groups and not replaced. This last trend worries many customary leaders who try desperately to fix the bride price to acceptable levels and to fine families who do not respect the ancient rules on the exchange of goods. However, they are unlikely to succeed as the traditional exchange of goods has already turned into a monetary transaction that no longer serves to strengthen links among the groups.

Last but not least, local people developed over time strong ambitions for their families and children. Their desire for educational and health services has rarely been met by government projects, especially in remote locations. Local people's frustration at the government for not providing adequate educational and health services has made communities willing to take matters in their own hands and strike deals with logging companies and plantation developers for these services. Aspirations for health care and formal education developed an increased dependency on cash earning activities. Considerable amounts of cash are necessary to pay for transportation, tuition and boarding fees, especially for higher education, as no infrastructure is locally available. Village dispensaries are seldom well-equipped, and if necessary people do not hesitate to go to Malinau or Tarakan for medical care[36].

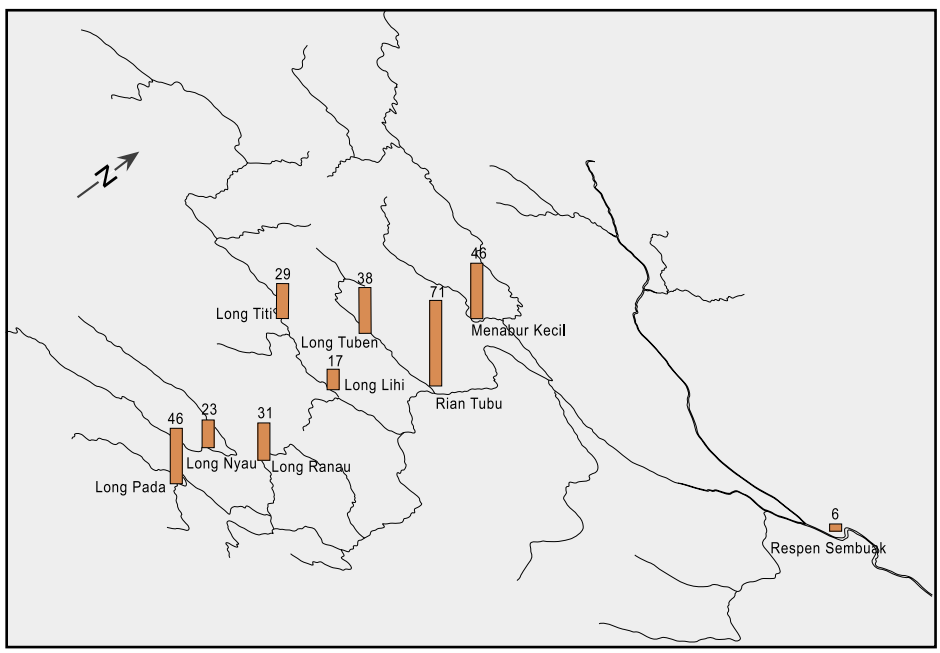
For all these reasons, forest people are increasingly dependent on cash. And, for the time being, the forest — for its timber and non-timber forest products, concessionaires and 'investors' — is the only potential provider of cash. As long as no alternative source of cash is made available to local people, the pressure on the forest is unlikely to be relaxed.

8. An overall dependency on accessibility

The comparison of the difference between upstream and downstream villages, between well- and badly-served villages leaves no doubt: accessibility is the main determining factor. Low accessibility has some advantages and many drawbacks. Be they Dayak or Punan, all agree that the main advantage of living in a remote settlement surrounded by primary forest is that 'meat is easy'. And by 'meat' people generally mean 'wild boar'. Bearded pig is always ranked higher than any other forest product, even cash-earning ones. Living closer to eaglewood-rich forests only reduces the length of a collecting tour from three to two weeks. Of little concern to eaglewood

collectors, this one-week difference is paramount for hunters[37]. Low accessibility is synonymous with preserved forest. But it also means high transportation costs and reduced competition among traders, low access to markets, and thus low prices for forest products and agricultural commodities, and high prices for manufactured goods. Bad communications with the outside world do not encourage teachers or paramedics to stay in the village. Being unable to access formal education further marginalizes upstream communities, while they pay a heavy toll in the absence of health care[38] see Figure 6.3).

Figure 6.3 Mortality rates in the upper Tubu (number of deaths per 100 births)



Punan family from the upper Tubu. Infant mortality is still very high

Good accessibility has many advantages but also some drawbacks. The opening of the road — and its good maintenance by concessionaires — between Malinau and Loreh had a tremendous impact on economic exchanges. Transportation time between the two localities dropped from one day by boat to three hours by car. The cost of outside goods was consequently reduced and new market opportunities were opened for local people, especially due to the influx of concession workers. Thanks to the new opportunities Loreh has been developing quickly: electricity, water supplies, a small hospital, television and VCDs are all now available. Such rapid development is not without its drawbacks. The intense activity of concessionaires leads to increased environmental damage, deforestation, air and water pollution, and disruption of traditional village life. Mutual aid among villagers gives way to individual enrichment. Competition for natural resources leads to conflicts with outsiders and among villagers, economic differentiation leads to *nouveau riche* behaviour and to jealousy, not to mention social pathologies such as alcoholism, gambling, and prostitution.

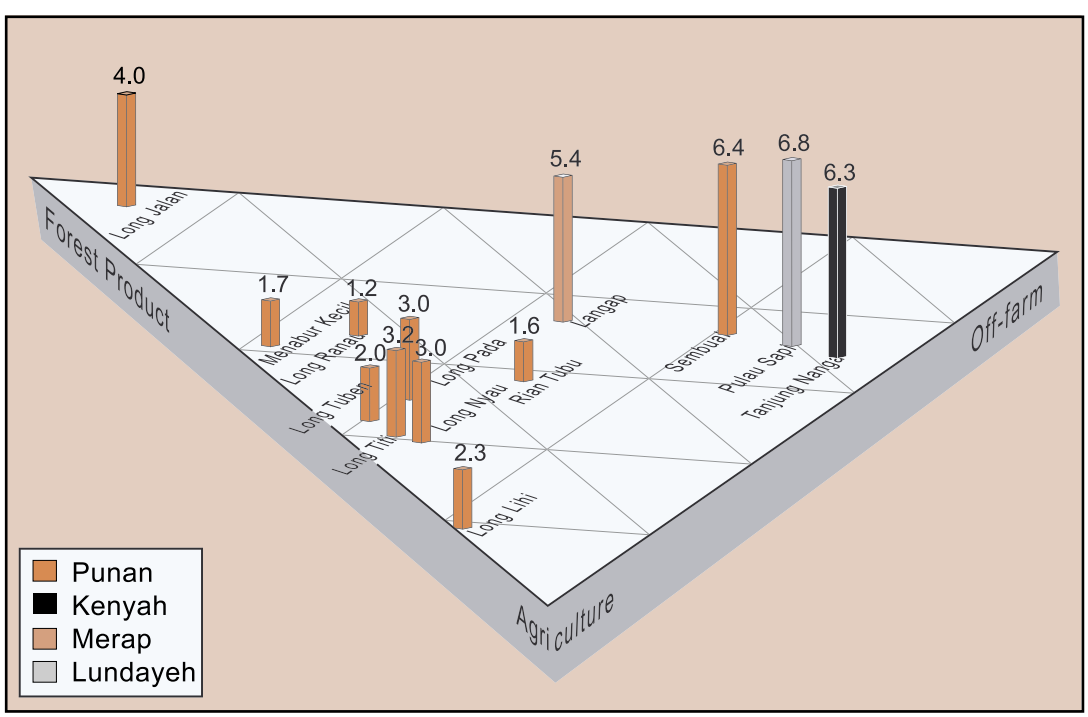
But for local people there is no hesitation: 'let's benefit from the advantages first, we'll deal with the drawbacks later'. And in the upper reaches of the rivers, where the countless rapids prevent the floating of the logs, there is no other choice than building roads to cash in on the royalties from IPPKs.

9. A general trend: securing cash income

By comparing villages in different locations and at different stages of development, a general trend comes to light (Figure 6.4). This trend goes from forest product gathering to agricultural activities and to salaried activities. Even in remote areas, forest people are no longer dependent on forest products for their staple food. Sago only plays a role as a safety net in case upland rice and cassava harvests are insufficient to meet the family's needs. In places where rice can be bought, sago is no longer part of the diet, as people prefer to buy their rice with the income provided by eaglewood collection. Nowadays dependence on sago as a staple is restricted to *mufut* periods.

Further downstream, where eaglewood is no longer available (or in the absence of traders), people

Figure 6.4 Average household income (million rupiah per year)



make a living from agricultural activities. There, swidden cultivation becomes essential, some people try their luck with plantation crops like coffee or cocoa, and forest products collection becomes a secondary activity during slack periods. Temporary work for concessionaires or 'illegal' logging is also considered an attractive option.

Even further downstream or in places close to concessionaires where salaried activities are available, swidden rice or lowland rice cultivation becomes secondary and is mostly entrusted to women. The men work for the concessionaires in the area and sometimes migrate temporarily as far as Sabah and Sarawak. In big villages like Pulau Sapi or in Malinau, many households benefit from regular wages and sometimes no longer practice agriculture.

This general trend goes along with the search for greater security and regularity in cash income and a more settled way of life. Pure foragers do not exist anymore but seasonal mobility is still high in remote Punan villages. For the Punan, settling down in a village implies adopting swidden cultivation. In the upper reaches of the rivers, where population density is low and eaglewood still available, most households specialize in forest product gathering. Eaglewood collecting provides a fairly regular source of income but what attracts collectors is the hope of hitting the jackpot — one lucky find and all your dreams come true.

In the middle reaches of the rivers, where people mostly depend on agricultural activities, securing cash income becomes problematic. Swiddens provide part of the household's staple food needs but not cash. Plantations such as coffee or cocoa are managed too extensively to provide regular incomes. At the present technological level — i.e. no fertilizing, infrequent weeding and no pest management — these plantations are unlikely to play an economic role either at the household or at the regional level. Promoting higher-level technology is unlikely to succeed, as it would imply higher costs in terms of inputs and higher labour requirements, which in turn would imply more financial risks for the farmer and lower returns per person-day. For the time being, agricultural activities cannot compete with the more lucrative opportunities offered by concessionaires and 'investors'.

Wage earning is the dearest wish of most heads of households, if not for them, then at least for their children. However, securing regular cash income also has numerous drawbacks. Local people still find it difficult to abide by the rules of salaried work: fixed working hours, targets, and restrictions on leave and so on. Positions as civil servants are still the most sought-after as they provide low wages but the highest degree of flexibility. They also provide pensions.

However, salaried jobs are set aside for skilled and educated personnel. Thus, local people are seldom successful when they apply for well-paid jobs at concessionaires. Know-how and education are required but are not in themselves sufficient, as family ties and ethnic relationships generally prevail over other qualities of the applicant. The local administration is clearly in the hands of the most prominent ethnic groups. A young graduate from a marginalized group has little chance of being considered. For the most enterprising, migrating to Malaysia was the easiest way to get a well-paid job until the outbreak of the Asian crisis. Nowadays the situation is more problematic for immigrants but the Malaysian option still has its advocates.

But today, for all groups, from Malinau to the upper reaches of the rivers, from the most prominent to the most marginalized, the best option of getting huge amounts of cash is to strike a deal with an 'investor' to sell one's forest to loggers[39].

10. The forest's last stand

Has local people's dependency on forest products been overstated? Certainly not from a cultural point of view. Interethnic relations, social organization, way of thinking, sense of wellbeing, and system of values still totally depend on the forest. But from an economic and materialistic point of view this dependency has decreased considerably over time. Formerly, to nomadic bands of Punan hunter-gatherers, sago and game was paramount to their subsistence. To settled Dayak swidden cultivators, the maintenance of the forest ecosystem was essential to the sustainability of the farming system. Bartering forest products, for prestige goods and salt, tobacco, loincloth and iron blades, was essential to the survival of both groups. But if one takes a close look at recent developments in the area, it is clear that the dependency on forests and forest products is not absolute but relative. Dependency on forest products is seldom the result of free choice; it is merely the sole option available. As we saw, forest people do not collect forest products

on their own initiative. Traders decide which product they want to buy; they organize the collection and control the marketing chain. As soon as new options are made available, i.e. labouring for concessionaires, wage working, migration to Malaysia, etc., the dependency on forest products is reduced. People analyse the options at hand in a rational manner, from economic, social and cultural viewpoints. They weigh the pros and cons of regular and secure earnings, of higher but riskier earnings, of short-term versus long-term employment, of local versus distant job opportunities, etc.

Nowadays, available opportunities are no longer restricted to forest product gathering. However, not all forest people are guaranteed equal rights to access these new opportunities. First, most forest people lack the know-how and level of formal education required for the most sought-after positions with concessionaires, the civil service and other private companies. Second, strong networks based on family and ethnic group links bar outsiders' access to better positions. Local people regularly complain about the preference given by concessionaires to Javanese, Bugis, Batak and other groups from outside Borneo. But the same rule applies in the local civil service, where Tidung, Kenyah and Lundayeh take the best at the expense of other ethnic groups. The Punan are by far the most marginalized for the reasons given above. Their exceptional knowledge of the forest confines them to the role of hunter-gatherers. But this is no longer a deliberate choice, especially among young Punan graduates, who experience a growing feeling of frustration.

This feeling is not restricted to Punan but also to other ethnic groups. Parents often make big sacrifices to ensure a proper education for their children, and both parents and children resent the absence of adequate job opportunities. Again, resentment is generally directed against outsiders to Borneo, which fuels the potential for ethnic conflicts.

Clearly, not everybody will be able to take advantage of ongoing changes. However, with the implementation of regional autonomy, some ethnic groups, and more precisely the leading classes[40] of these groups, will probably be able to compete with outsiders. But the poorer classes and the marginalized communities will likely remain dependent on forest product gathering to make ends meet. But for how long will they be able to rely on the forest? Eaglewood is already depleted and no other NTFP is likely to take over its role. *Damar* resin and rattan are plentiful in the forest but traders are not interested. Plantation crops like coffee, cocoa or oil palm? For the time being, the returns from agriculture cannot compete with other opportunities at hand. Forestry plantations? Planted forests might be the best option for the future but not while large stands of primary forest are available in the vicinity.

Forest people from the Malinau district cannot be labelled as poor. With little exception, all still have access to relatively good sources of cash and no one ever experienced starvation[41]. Poverty in Malinau is not linked to income but to lack of access to education and health facilities. In the upper reaches of the Malinau and Tubu rivers, there are no schools and sanitary conditions are appalling. Most people are illiterate and children pay the heaviest toll. In order to alleviate poverty in these remote areas, the government decided some 30 years ago to resettle villages in areas closer to the district capital. Over time, the resettlement proved a success, at least in matters of access to education and to healthcare. Recently, as resettlement is no longer considered a viable option, the district government decided to build roads linking the remotest villages to the district capital. This much-awaited move gained the support of most local people but frightened conservationists.

The latter have every reason to be worried. Once opened up, the rich primary forests of the upper Tubu and Malinau will fall victim to the loggers' greed. Most communities of the Tubu have already contacted 'investors' in order to attract them to their village. None of these so-called 'investors' is ready to invest in road building, but as soon as the area is opened up, no doubt they will flock in in great numbers. Local communities seem little concerned about forest conservation and are not afraid of deforestation. In fact, there is little awareness of the consequences of deforestation. These communities have always lived in or close to the forest. They believe — or want to believe — that the loggers will just remove a few logs without destroying the forest, or that they will convert the forest into productive plantations. It is hard to say to what extent they are fooled by 'investors' or they fool themselves.

It is difficult to hold it against them. Local communities are in dire need of hard cash and, for the time being, the forest represents the 'best' — if

Small Punan settlement in the upper Tubu. None of these children were able to attend school

not the only — way to obtain a large amount of cash quickly with a minimal input of labour. No other opportunity can compete with it. And as long as this opportunity is open, no other development will be conceivable.

Up to now, there has been no real conflict over the use of the resource between shareholders or even among the communities. The local government receives taxes and local communities receive royalties, while 'investors' strike more profitable deals than ever[42]. There is a clear consensus on the use of the forest; any conflict is only about the sharing of the benefits. In that sense communities have become increasingly interested in territorial matters, mapping village areas and fixing and materializing borders. Anteriority of settlement in the area has become a disputed issue, as well as former political dependencies. Affirming the community's legitimate ownership and rights to the resource has become the main concern of community leaders.

For the resettled communities of the Tubu watershed, such concern has unprecedented implications. To the nomadic Punan hunter-gatherers, living in a village is something rather recent and the concept of village territory traditionally unknown. The forest resources of the Tubu watershed are open access to all Punan Tubu. The rate of intermarriage is very high between all villages and only former swiddens or orchards or birds' nests caves are clearly appropriated. The forest is not. Thus, it is difficult to secure one's ownership over former village territories without being physically present. As a consequence, most village leaders in Respen are considering moving back to their former village to reinforce their claims and to avoid conflicting claims over their land (Kaskija 2000). At the same time, families from upstream settlements who planned to move downstream are reconsidering their decision.

For the time being, everybody's hopes are pinned on the forest. Not as a sustainable source of forest products, not as a support for an ancient way of life, but as a principal source of hard cash. The risk is great that the first IPPK will be followed by many others. If nothing is done to counter the present trends, in a short while, one of the last stands of lowland dipterocarp forest of Borneo will end up as sawn timber, plywood, pulp and paper. The risk of seeing forestland converted into wasteland is high. Some people might benefit from the process, and it is easy to imagine who will be on the losing side.

However, it is not all doom and gloom. The local people's commercial orientation and strong aspirations for development are in itself a very valuable resource. The education level is rising quickly, accounts from deforested areas become available and conservation issues are often discussed

among villagers. Many wonder if a future without forest would be a viable option. With the implementation of regional autonomy local people have an opportunity to take matters into their own hands. Dayak and Punan in general, because of their history of trade in forest products, strong migratory history, and decision-making structure that favours a combination of village debate and reliance on key aristocratic elders, has profound implications for how they respond to new economic opportunities. Up to now, these opportunities have generally been seized by local elites. However, more and more people question their leaders' choices and long for a more democratic decision-making process. Reconciling development and conservation objectives in Bulungan is not (only) a technical problem but a rather a matter of good governance. The next chapter will explicitly look at the prospects of communities making their aspirations heard.

Endnotes

[1] In one case, data was obtained on the condition of providing private lessons to the fishmongers' children.

[2] Exchanges of goods, labour, information, knowledge, know-how, etc. and marital exchanges.

[3] In year 2000/2001, only 7% of the households did not open a swidden.

[4] *Sus barbatus,* commonly known as the bearded pig.

[5] During headhunting times the Punan were feared for their ability with blowpipes and skill in preparing poisonous darts.

[6] *Strychnos* sp. and *Antiaris* sp. are commonly used for preparing blowpipe poison. *Dioscorea hispida* and *D. piscatorum* as well as *Derris elliptica* are used for poison fishing.

[7] *Asplenium, Lygodium, Nephrolepis, Diplazium* and *Pteris* spp.

[8] *Artocarpus odoratissimus.*

[9] *Eusideroxylon zwageri.*

[10] *Licuala* spp. leaves are the favourite material for thatching, but other leaves (*Marantaceae* and *Dilleniaceae)* may also be used.

[11] At least every two years for a vegetal roof.

[12] Three species of palm are locally used for sago: *Metroxylon* sp., *Arenga undulatifolia* and *Eugeissona utilis*.

[13] *Tidak mau cerai dengan daging.*

[14] *Sarang lumut* in Indonesian.

[15] *Aquilaria* spp. or gaharu in Indonesian.

[16] Eaglewood or eaglewood is a resin produced by various trees of the *Aquilaria* genus. The resin is produced as a reaction to fungal infection following injuries. The tree is chopped to pieces during the harvesting process, which is why the resource is fast disappearing.

[17] The Punan claim that outsiders being unable to recognize trees containing resin carelessly chop down any *Aquilaria* tree, thus compromising the renewal of the resource.

[18] The city of Malinau is predominantly Muslim, thus animals must be killed according to Islamic rites, and of course pork is prevented from entering the market.

[19] Mostly belonging to the Tidung ethnic group.

[20] They often blame outsiders for using destructive techniques as long as they are not in a position to do the same.

[21] Two traders run shops and have more or less permanent representatives in Long Jalan. Other traders occasionally visit the village and try to divert the local production.

[22] Malaria outbreaks are frequent while camping in the forest.

[23] Called *ongkos*, this credit in kind — rice, salt, tobacco and medicine — covers the collector's and his family's basic needs.

[24] Especially on steep slopes. Yields are always higher on flatland or at the foot of the slopes where ashes concentrate.

[25] In remote areas like in the upper Tubu, there is not a big difference between living on a swidden or in the village. Thus, some families or group of families may choose to live on swiddens even far away from the village. In Long Pada, for instance, some families live at a one-day distance by foot.

[26] Lowland rice cultivation is also commonly practiced by elderly people lacking the manpower to clear swiddens.

[27] Special attention was given to five 'concessionaires': the mining companies BDMS and John Holland, the logging companies INHUTANI I and II and the international research institute CIFOR. The local communities concerned were: Seturan, Langap, Long Loreh, Bilah Bekayuk, Sengayan, Plancau, Gong Solok, Batu Kajang, Tanjung Lapang, Pimping, Terasnawang and Salim Batu.

[28] PMDH stands for *Pembinaan Masyarakat Desa Hutan* (forest community training programme).
[29] The influence of mass media (radio and television) has probably been more determining.
[30] IPPK stands for *Izin Pemungutan dan Pemanfaatan Kayu* and addresses smallscale logging concessions attributed by the Bupati.
[31] In August 2001, three roadblocks were organized between Loreh and Malinau in the same week. Compensation of Rp. 3 million was demanded for a dog run over by a truck. The deal was settled at half this amount.
[32] And by the number of trophies, i.e. heads severed.
[33] Another opportunity was the capture and sale of slaves to the coastal kingdoms (Sellato 2000).
[34] A stratified social organization appears in most ethnic groups. More research is needed on this subject.
[35] In upstream villages, the life of a long-tail engine seldom exceeds two years.
[36] In theory the Malinau dispensary sends a medical team upstream every three months for check-up, vaccinations, etc.
[37] First, conserving wild boar is problematic. The meat is either pickled in brine or smoke-dried; in both cases it loses its taste. Second, organizing a hunting party to the upper reaches of the rivers is expensive and not profitable as the product of the hunt is traditionally shared among all villagers. Only on special occasions, such as marriages, do Punan families from Respen organize a hunting party in order to provide guests with delicacies.
[38] In the upper Tubu, one child out of two dies before the age of five. This figure drops to one in three in the middle Tubu, and one in ten in Respen.
[39] Underlying motivations to this behaviour still need to be explored. Today local people want their share of the manna from timber extraction. The dominant perception is that the forest will disappear anyway, so better take one's share as quickly as possible. Persistent legal uncertainty is also favouring the unsustainable use of the forest.
[40] It is no surprise that the leading ethnic groups are also the most stratified ones, and that the aristocratic classes of these groups have been able to maintain their dominant position.
[41] Though some food shortages during El Niño years and occasional malnutrition cases have been reported.
[42] Before the implementation of regional autonomy, neither the local administration nor local people benefited from logging. Timber barons had to obtain authorizations from Jakarta and to bribe bureaucracy at the highest levels of the state.

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7. Negotiating More than Boundaries:
Conflict, Power and Agreement Building in the Demarcation of Village Borders in Malinau[1]

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In Malinau, the poor and the more powerful increasingly compete for the same land and forest resources. Swidden farmers, hunter-gatherers, timber companies, mining companies and local government make diverse demands on the forest. Yet coordination[2] of forest management among these different land users has been weak. During the implementation of decentralization reforms between 1998 and 2001, when demands on the forest increased and local coordination was at its lowest, social conflict increased dramatically and forest degradation occurred at unprecedented levels.

Malinau is not unique. Large forest landscapes everywhere are under increasing pressure from diverse and incompatible demands. In this report we argue that unless appropriate mechanisms are in place for forest users to coordinate among themselves, large forest landscapes such as those in Malinau are subject to the risk of escalated and entrenched social conflicts, increasing social injustice, open access competition for resources and even wilful destruction of forest resources. Because of recent reforms, stakeholders in Malinau face the additional challenge of making a transition between the top-down more coercive coordination by forest departments in the 1970s to 1990s, when conflict was rarely openly acknowledged, to more deliberative[3] and pluralistic coordination, where self-organization, transparency in government, conflict management and greater citizen participation in decision making (DiZerega 2000, Anderson *et al.* 1999) guide decision making.

We report here on the findings that lead us to these conclusions.[4] We focus on village-to-village coordination as a subject that has received little attention, yet is fundamental to multistakeholder processes. We were interested to know whether the principles guiding more formal and complex multistakeholder processes were relevant to intervillage coordination, where lower numbers of people, more familiarity among people and more of a moral economy and stronger kin obligations occurred. We asked the research question: *What conditions facilitate coordination of interests within and among villages?* We were also curious to learn more about local people's concepts of conflict and agreement in Malinau and how these might be changing during the reform period. The work focused on village boundary demarcation as a means of land use coordination and as a tangible source of conflict about which agreements could be negotiated.

Below we briefly present current thinking about coordination processes, our study methods and a history of village-level coordination efforts in Malinau. We then present the results of the study, with data about sources of boundary conflict among communities and how they sought to overcome that conflict. We conclude with recommendations.

Background

What constitutes 'good' coordination in forest management? During the last two decades, proponents of community management have often advocated that the state should decrease its involvement as the primary coordinator of local

management (Poffenberger 1990, Sarin forthcoming). However, where government coordination has been weak, local entrepreneurs and strongmen often gain control over the forest at the expense of communities (Kaimowitz 1999, Barr *et al.* 2001, Dove 1993). A new paradigm is emerging in which coordination occurs through more pluralistic processes that take into account the interests of different stakeholders. In these multistakeholder processes, the central challenge is 'how a society composed of formally equal citizens could be ordered so that those having access to more political resources, luck or talent would not use their advantages to exploit others weaker than themselves' (DiZerega 2000).

To answer this challenge, current principles of multistakeholder processes in forestry suggest that coordination should be grounded in negotiations that involve all relevant stakeholders, identify their interests, facilitate effective communication and learning, create a neutral space for interaction, and seek to achieve consensus (Allen *et al.* 1998; Borrini-Feyerabend 1996; Fisher 1995; Röling and Wagemakers 1998; Röling and Maarleveld 1999; Porter and Salvesen 1995). Iterative cycles of conflict and adjustment are likely to occur and conflict should be managed (Lee 1993, Ramirez in press).

Experience in forest areas—including formal co-management agreements between states and communities and the decentralization of decision-making authority—indicate, however, that some of these aims might be unrealistic and even work against politically weak groups, such as local forest-dependent communities and vulnerable groups within communities (Contreras *et al.* 2001; Sundar forthcoming; Edmunds and Wollenberg 2001; Wollenberg *et al.* in press a; Anderson *et al.* 1999; Baviskar in press; Antona and Babin in press).

We argue that a more realistic view of coordination thus requires modification of these principles. First, in contrast to certain current beliefs about conflict mediation, there is strong evidence to suggest that it is difficult, if not impossible and undesirable, for facilitators or people engaged in negotiation to define stakeholders' interests clearly. Interests are many-layered and we tend to construct our interests in response to specific contexts and for strategic purposes (Baviskar in press, Leach and Fairhead in press). Especially where trust among groups is low, it may be unwise to reveal one's true interests or to assume that other groups are communicating their interests honestly. Baviskar argues that we can best infer interests from people's actions, not from what they say.

Inter community meeting in Setulang

Second, as suggested by proponents of pluralism (Anderson *et al.* 1999, Rescher 1993, Bickford 1999), consensus is impossible and participants in a multistakeholder process should treat agreements as inherently partial and unstable. Complete agreement is impossible because differences in experiences prevent even two individuals from ever having the same desires (Rescher 1993). As only temporary states of coordination can occur, coordination is best thought of as a process of ongoing accommodation and negotiation involving multiple actors. Agreements are not the end of the process, so much as a set of principles providing guidelines and legitimacy for new actions. People negotiating contractual agreements and management plans should therefore build in flexibility to accommodate adjustment and acknowledge these as temporary measures (Wollenberg *et al.* in press b). Boundary agreements should acknowledge flexibility in rights allocated across borders. Facilitators of coordination should work with the plurality of institutions with which local actors interact, and not just through single user groups or local forest departments (Leach and Fairhead in press).

Third, some parties consistently enjoy disproportionate control over coordination processes. Weaker groups' interests have been routinely excluded, represented ineffectively, co-opted or negotiated away (Anderson and Grove 1987, Hecht

and Cockburn 1989, Parajuli 1998). Power has been exercised according to who assumed the convenor and facilitation roles (or controlled these roles), who was represented in the process, and differing capacities for communication and negotiation among participants (Steins and Edwards 1999, Ramirez, in press). Government agencies have often assumed this role in regard to forestry by working in an expertocratic mode that relies on opinions of professionals rather than wider citizenry (Rossi 1997: 237). In these situations, the interests of disadvantaged groups are often masked under the guise of agreements (Edmunds and Wollenberg 2001). Well-intentioned efforts to expand participation in forest management by including marginalized groups can actually work to their detriment, unless certain checks and balances and accountability measures are used. Multistakeholder negotiations are likely to be more socially just by acknowledging existing power relationships and enabling disadvantaged weaker groups to work politically in more effective ways, rather than assuming that negotiations can ever be neutral.

From the points documented above, we suggest that more strategic principles[5] for multistakeholder processes are necessary. These require facilitators to manage sensitively and for participants in the processes to demand. Any group or coalition that takes the facilitator role will seek to meet their own self-interest to some extent, so it is necessary for the group of participants to collectively agree on norms, rules and sanctions that encourage socially responsible facilitation. Principles include the following:

- Acknowledge the fluid and complex nature of interests, agreements and coordination processes and encourage institutions that enable multiple groups to communicate, debate and negotiate about these. Create agreements and coordination mechanisms that can acknowledge underlying conflicts and accommodate flexibility and adjustment. Assess interests through people's actions, not statements.

- Improve the preconditions for disadvantaged groups to participate and negotiate effectively. Seek out possibilities for alliances among select stakeholders, rather than trying to achieve an apolitical agreement among all stakeholders. Working in, with, and through alliances, disadvantaged groups can achieve significant gains for themselves, while maintaining greater control over the types of information made available to their antagonists. Enhancing the power, urgency or legitimacy associated with certain stakeholders can increase the likelihood of their being noticed and involved in decisions (Ramirez, in press). Enable excluded stakeholders to work through parallel arenas to challenge decisions.

- Ensure accountability of coordination decisions to interest groups through effective representation (facilitating proximity of leaders to their constituencies, elected leaders and delegates and fostering an ideology of civic dedication), transparency (third party monitoring, public meetings and reporting, participatory processes), and checks on power (legal appeals to existing decisions, separation and balance of decision-making power across several authorities, enabling civic education and social movements) (Ribot in press).

- Situate the legitimacy of negotiation processes, decisions and agreements. This means analysing the reasons for participation or nonparticipation by each group in negotiations, how groups are represented, the roles of convenors and facilitators, and the historical context for such agreements. It also means treating legitimacy as partial and contingent rather than assuming that an unproblematic legitimacy is assured through open negotiations.

To test the applicability of these principles and refine them, we examined the extent to which they were relevant to village-to-village coordination about land claims in Malinau. We report our findings below.

Methods

CIFOR used action research to examine negotiation among stakeholders in relation to forest land claims and coordination of land use in the 27 villages of the upper Malinau River (see Map). Action research enabled us to conduct research that would mutually benefit CIFOR and local stakeholders by generating

local impact immediately, as well as enable us to directly observe how these impacts occurred. The methods and focus of the work evolved in response to local needs in iterative stages.

Initiation

We began in the village of Long Loreh in 1997, where we stationed a local research assistant to collect baseline information about forest dependence, villagers' concerns and local governance. In early 1998, we explored developing scenario-based methods as a tool for building a common vision and negotiation among stakeholders. At the time, there was little local interest in these methods.[6] We looked for another entry point for collaboration and action research, and in the meantime, produced a review and guidelines to scenario methods for multistakeholder planning (Wollenberg *et al.* 2000; Wollenberg *et al.* in press a, b). These have been shared in training seminars and international conferences.

Because of the opportunities for community land claims created with reform under President Habibie, we subsequently explored research on methods for different groups to reach agreements about village boundaries, using participatory mapping of village lands as a platform. WWF's participatory mapping of village territories or *tana' ulen* in Kayan Mentarang National Park also provided a precedent. We conducted training in participatory mapping with the NGO SHK in the village of Long Loreh in late 1998. Communities' interest in settling land claims was high, and other communities expressed a desire to join the process. We decided to also gather more information about other communities to better understand their perceived problems and priorities and subsequently expanded our work area to the 27 villages of the upper Malinau River.

In 1999, we conducted a systematic survey of stakeholders, land tenure and forest-related conflict in these 27 villages, as well as organized a five-day community workshop involving representatives from throughout the watershed to identify a mutual agenda for collaboration between communities and CIFOR (Padan and Laway 1999, Anau 1999, ACM-CIFOR 1999). The survey demonstrated that all the communities had a strong interest in mapping their lands. The workshop showed that villagers' highest development priorities were securing reserved or protected forest, clean water and electricity (and other infrastructural improvements), in addition to the mapping of village boundaries. The activities also revealed high levels of conflict among villages and between villages and companies about a range of forest-related issues, including land claims.

Participatory mapping of administrative boundaries

In response to the high interest in mapping, CIFOR trained village-level committees in participatory mapping techniques and, from January to July 2000, facilitated conflict mediation and mapping among the 27 villages. CIFOR created a core team of nine trainers-researchers-mappers that included six Malinau community members. This team documented and analysed the types and causes of conflict over boundaries (Tim Pendampingan Pemetaan Partisipatif, 2000). Twenty-one villages produced draft maps. A community workshop was held in 2000 to review next steps with the communities. Communities recommended that CIFOR continue to mediate the boundary demarcation process, although local government at the same time expressed an interest in taking on the mediation and mapping themselves. Because of the long-term nature of boundary adjudication and the role of local government in approving boundaries, CIFOR and the Malinau District government recommended that local government would be better placed to continue the mapping. Communities also requested more information about decentralization, local government and negotiation methods for dealing with IPPK (*Izin Pemungutan dan Pemanfaatan Kayu*[7]*)* holders.

In each village the steps planned by the Core Team to facilitate community mapping were:

1. The Core Team initiated work with a community once they had had internal discussions and negotiations with neighbours to decide their boundaries and had formed an internal village mapping committee of five to six members.
2. The Core Team began by facilitating a community meeting to discuss the purpose of mapping, the process, the responsibilities of the community and how they wished to store/control use of the map once it was finished.

3. The Core Team trained the village mapping committee in GPS (Global Positioning System), compass and mapping skills.
4. Together the Core Team and village mapping committee visited boundary areas to collect GPS points. Those areas that could be mapped according to topography or rivers were drawn in on a satellite photo. The Core Team provided leadership in these activities.
5. Both teams entered GPS points to the satellite photo and a base map.
6. At the completion of fieldwork, the Core Team reported about the process and results of mapping back to the community.
7. One draft map was left with the community, and the other was sent to Bogor for processing by CIFOR.
8. Processed maps were returned to communities for crosschecking.
9. Communities begin negotiations with government to acquire legal recognition of their boundaries.

We faced several challenges in implementing these steps fully. Although we attempted to genuinely build the capacity of local villagers to undertake the mapping on their own, we found that few communities, even after several training sessions and experience in mapping, were able to participate in the mapping as much as we had expected (see discussion below).

The Core Team also helped to mediate conflict on several occasions when requested to do so by communities. During the mapping and separate monitoring activities, Core Team members observed conditions affecting how agreements were reached. They also observed the types of conflicts occurring and the strategies of communities to achieve agreements.

The Core Team was not always able to hold meetings about the results of the mapping because community members were often preoccupied with other business and the large distances and tight schedule did not permit the team to wait in an open-ended way for village leaders to call a meeting.

The project was not able to complete the last two steps of the mapping because of the requests for changes in boundaries and the lack of information about how to formally recognize the boundaries. From July 2000 until the end of the project period (December 2001) the completion of the process was therefore put on hold in anticipation of the local government's plan to facilitate the conclusion of the mapping.

Land use under decentralization

Beginning in 2001, because of the increasing conflicts about land use among all stakeholders and rapid deforestation, CIFOR decided to broaden the stakeholders in the project. To that end, CIFOR and the Malinau local government co-sponsored a multistakeholder workshop in May 2001,[8] involving 69 participants including the Malinau local government, local concession holders, 19 community members (additional community members were also represented in government and NGO positions), church leaders and NGOs. The participants identified their shared hopes for the future:

- Increased income
- Land use that is clear and occurs according to assigned rights and functions
- Development of institutions that are efficient, coordinated and transparent
- Environmental conservation.

Participants jointly produced action plans to achieve these desires. These plans included the recommendation that land use and boundary decisions should include participation of representatives of all affected groups in all stages, from field inventories to rule making and implementation. The meeting was the first-ever multistakeholder meeting of its kind in the district. Participants, especially local villagers, were highly enthusiastic about the opportunity to meet with so many different groups to discuss these issues together. The meeting created a high level of optimism and good will about the potential for future stakeholder collaboration.

CIFOR is presently in discussions with local government to determine a program for next year to follow-up on these recommendations. We have been also working intensively in the Loreh and Langap sites (seven villages, four ethnic groups) to discuss with communities their priorities for action related to decentralization and land use management. A workshop will be held in November with the communities of the upper watershed and other stakeholders. Two members of our team, sponsored

by the Ford Foundation, have been preparing legal literacy materials for communities and local government.

Preliminary outcomes of these discussions indicate strong interest from communities and local government in:

- Completing the conflict mediation and boundary demarcation process
- Improving understanding of future economic options for increasing local incomes
- Improving legal literacy related to decentralization and community rights
- Identifying ways of reserving forests for local use and protection.

During the course of these three phases of work, we have worked with officials in the *kabupaten* and *kecamatan* offices, Bappeda, INHUTANI II, Meranti Sakti (another local HPH), and *Dinas Kehutanan* at the provincial and *kabupaten* levels of government, mostly in the capacity of exchanging information about our plans. We have also collaborated with Plasma, SHK-Kaltim, PPSDAK, Padi, LPMA, the University of Victoria (Canada), Wageningen University and Yale University in various components of the work. We have coordinated with and informed partners in Samarinda periodically, particularly Plasma, SHK, Putijaji, APKSDA, The GTZ Sustainable Forest Managament Project and WWF-Kayan Mentarang (now in Tarakan).

Committee members of two neighbouring villages collect GPS coordinates along the village border, assisted by members of the facilitation team

The context for struggles over land and forest

Struggles over land and forest in Malinau have been long-standing, even if the reasons and means of managing them have changed. We can trace the shifting authorities that worked to overcome these struggles and served to coordinate control over land during the last several centuries. For the earliest periods we can only draw evidence from historical documents, oral histories and try to extrapolate from conditions observed in more 'traditional' villages, although the latter is risky (see Sellato in press for a historical overview of Malinau during the last 150 years).

At least until the early 1900s, intergroup warfare was common, as was migration in response to the threat of war. Minor customary leaders (*kepala adat*) and their circle of close advisors helped to control access to land, manage conflicts and coordinate decisions within their ethnic group, while major customary leaders (*kepala adat besar)* helped to coordinate these matters at yet larger scales. Most settled rice farming communities (e.g. the Kenyah) seem to have sought control over territories, while others (e.g. the Punan) seem to have been more concerned with access to settlements and key resources. Where they existed, territories seem to have been conceptualised in terms of a central settlement point or river and its watershed, with less emphasis on the exact location of the outer bounds. In many places, customary leaders controlled rights to valuable resources like birds' nest caves nested within the territory of a sultanate.[9] The sultanate in turn levied taxes on the traded products.[10]

Coordination occurred through these customary leadership structures, which used hierarchical social controls within their villages and periodic consultation—especially with a close circle of

influential villagers or *tokoh masyarakat*—to manage conflict within the group. Unresolved conflict was handled though the fission of the group, with one faction moving to a new settlement or, in the case of external groups, by violence. Around 1900, Kayan groups repeatedly attacked Merap groups on the Malinau to reclaim caves taken over by the Merap. Marriage or trade alliances were used to build relationships with external groups. Rights of access to village territories were based on these ethnic and trade alliances as well as respect for customary authority, requests for permission and verbal agreements, although people often casually entered watersheds for hunting or collection of forest products without permission. Rivers and mountain tops marked boundaries. Reflecting the economic value of forests at the time, some leaders requested fees from outside groups wishing to collect forest products in their area (Sellato in press). Evidence suggests that in the upper Malinau, the Merap *kepala adat besar* was the reigning local power, together with the local Tidung Sultanates, for most of the 20th century.

As warfare declined, the Dutch[11] and later in 1950s the Government of Indonesia[12] became additional layers in the institutional hierarchy in what was first the Bulungan sultanate and later the *kabupaten* or district of Bulungan. The new Indonesian government established an infrastructure of centralized control. The role and direction of accountability of customary leaders became muddled over time as many were appointed by outside officials as village government heads (*kepala desa*) and became upwardly accountable to a *camat*, *bupati*, governor and the president. Local social institutions were severely weakened with the delegitimation of customary laws and leaders. Government maps of villages bore little, if any, relationship to actual settlements and their claims. Unfortunately, local villagers became increasingly politically disenfranchised and distanced from under this system. Most matters of village concern continued to be settled by customary leaders, especially those who also worked for the government as *kepala desa*. These leaders made decisions among a group of ethnically homogenous people. Access to land and forest continued to be managed as before.

In addition to establishing new administrative overlays, the state staked extensive claims to forested territories starting in the 1960s as the timber boom began. Nearly 95% of what is now the district of Malinau was designated as state forest land, and in the late 1960s the central government allocated all the state forest land to timber concessions. Suddenly villages found themselves sharing the forest with timber harvesters and being told that the land belonged to the government of Indonesia. The state's assertion of authority over land through the logging companies' presence openly challenged local sovereignty and claims to land in a way that sultans and the Dutch had never done. Villagers for the most part accommodated the concessions, largely out of feelings of intimidation (military officials usually accompanied logging company staff or otherwise harassed potentially troublesome villagers). The gradual degradation of forest, loss of wildlife for hunting and lower water quality that they experienced were also partially offset by the construction of roads, provision of transportation, generation of employment (albeit limited) and occasional contribution to a village project. Local concessions did not strictly enforce hunting and burning prohibitions and allowed swiddening in some forest areas in an effort to maintain good relations. During this time, forest-related conflicts were predominantly intervillage quarrels about access to agricultural plots and for a few individuals, efforts to maintain claims to birds' nest caves. The state did not allow conflicts with the government or concessions to occur.

The authority of village customary leaders further eroded and land claims became more complex as ethnic groups began to share territories. Government resettlement programs of the 1960s through 1980s, and an *ad hoc* case of government-sponsored resettlement in 1999, reallocated mostly formerly Merap[13] lands along the upper Malinau River to Dayak groups who had moved from more remote parts of the area. The newcomers did not, however, always sever ties with their former territories. As a result of these programs, two to four ethnic groups now reside collectively in each of nine of the 16 settlements (*lokasi*) along the upper Malinau River. Population pressure has also increased substantially on local resources. These groups now make claims to multiple territories that overlap with other group's claims, calling into question who maintained authority over which land and what the role of customary and government authorities is in settling these claims. Because of the resettlement programs, the upper Malinau River area suffers more from these sorts of multiple claims than any other part of the district.

The final and most recent major development occurred with three overlapping phenomena: decentralization reforms, new access for villagers to monetary payments for timber and land and the creation of the new *kabupaten* Malinau. With the initiation of decentralization and the associated uncertainty, local people from all sectors of society have sought to seize their share of Malinau's resources. Even before decentralization policies were formally implemented at the *kabupaten* level, *de facto* decentralization began taking place with villages making claims to *adat* lands and negotiating directly with local investors (Rhee forthcoming). Villagers made demands for compensation or benefits from timber and mining companies more freely and requested larger amounts than ever before.[14] Since former President Soeharto stepped down, villagers say they can express their discontent without fear and have been much freer about speaking out against their leaders and the government. Military officials only rarely accompany timber companies or government entourages any more. New political associations have formed among different ethnic groups. Village leaders can be seen as often in the central town of Malinau, meeting with government or company officials as they are in their own villages.

Fuelling the race for resources was the offer of payments by companies for harvesting timber. In 1996, the exploitation of coal in the Loreh-Langap area resulted in payments to some 10 to 20 households and to the customary Merap leader of Langap for rights to excavate their fallowed swidden fields. In 2000, the Governor of East Kalimantan passed a provision (stimulated by the new Basic Forestry Law 41, 1999) enabling communities to claim compensation from timber companies for logs harvested in their areas.

The most lucrative deals, however, were the IPPKs, or *Izin Pemungutan dan Pemanfaatan Kayu*. Beginning in April 2000, the *Bupati*[15] began allocating these small scale logging permits for 100 to 5000 ha each to hastily formed small local companies (CVs). With decentralization, the *kabupaten* became responsible for generating its own income, and could also keep a larger proportion of the income it generated than ever before. The incentives for intensive resource use were therefore high. The presence of the Kayan Mentarang National Park increases the pressure on the *kabupaten* to make more intensive use of the remaining areas, such as the upper Malinau River, which are also more accessible and have better infrastructure. The result has been extraordinarily high levels of timber extraction among more diverse groups and increasing conflict among nearly all parties, including smallscale timber harvest permit holders, concession holders, villagers (themselves often forming factions) and mining interests (Barr *et al.* 2001). Thirty-eight IPPKs have been issued granting access to more than 53 000 ha in Malinau since April 2000. Underlying the logging deals has been the negotiation of territorial claims and speculation about the value of these lands for future claims or compensation. A *laissez-faire,* frontier atmosphere has emerged in which making money has become more important than always being lawful or fair.[16]

The symptoms of trouble are clear: community protests against the investors for not paying expected fees or wages to local harvesters; complaints among villagers about opaque deals struck between leaders and investors; and forest logged in areas where permission was not granted by villagers. In most villages, few people know the content of the evolving law or are aware of their entitlements. Usually only a select elite close to the village head (*kepala desa)* are involved in *kabupaten* matters and negotiations with investors. Many villagers are excited about trying new economic options, but lack the information about how to consider trade-offs in livelihood security and long-term resource use. The communities' euphoria—unchecked by a lack of information—about receiving several thousands of dollars now will most likely be forgotten in a few years when both the forest and their money have run out.

In addition to the above, the formation of the new *Kabupaten Malinau* in October 1999 (one of three new districts formed from the district of Bulungan) has meant that there was a one and a half year period of temporary leadership of the district that was not accountable to a local assembly. Not coincidentally, this was also the time when the bulk of the IPPKs were issued. Many government offices were only filled in 2001, including the forest service (*Dinas Kehutanan*). Another significant aspect of the new local government is that for the first time, most posts were filled by people originating from the *kabupaten* (or married to someone from the *kabupaten).* Previous officials were mostly from Java, Sulawesi or other parts of Kalimantan (especially

Samarinda or Banjarmasin). The Dayak-ization of local government has meant that authority is now rooted in the local politics of more than 18 different ethnic groups. Local relationships of power are more intertwined and complex than ever before.

These evolving relationships have affected how struggles over land play themselves out. Current alliances in Malinau reflect a set of fluid, interlocking networks of ethnic affiliations, economic interdependencies, strategic kin relationships and even historical alliances from the headhunting period. Kenyah, Lundaye and Tidung groups have been the most politically aggressive groups in recent years and dominate Malinau's new local government. These groups, together with the Merap, have also worked most aggressively to consolidate their claims to land. Punan groups, meanwhile, have had little representation in the *kabupaten* government, as well as weak historical claims to lands, and are always the weaker partner in alliances with other ethnic groups.[17] Individuals from all groups have maintained an opportunistic attitude towards building alliances and sought to strike new deals as they may, making it difficult to know at any one time precisely who has control where. Unfortunately, only a relatively small group of leaders and their circles enjoyed the benefits of these deals and exerted any real influence over decisions.

Decisions made in the next several years will have huge consequences for who controls land and how that land will be used in the medium term. Current trends indicate very real threats of rapid deforestation, disenfranchisement of the Punan, and ultimately the loss of opportunities for long-term economic gain by most local groups. As one of Asia's largest remaining expanses of continuous forest and home to the largest group of Punan in Borneo, it is vital that coordination be improved to encourage a longer-term and more integrative view of how the areas's forest can be managed to provide more equitable and long-term benefits for local communities. Local stakeholders feel these challenges intensely.

Setting Village Boundaries

It was in the context of this last set of developments that CIFOR's action research on intervillage boundary conflict took place. Below we report our results. We report on the lessons learned about the types of conflicts encountered, the factors influencing how communities reached agreements, and the impacts of the boundary demarcation process. We also note some technical lessons learned about the participatory mapping process.

Sources of Conflict

The most common sources of conflict between villages over boundaries were the overlap in ownership or use of agricultural lands (swidden fields, wet rice fields and perennial gardens) and a history of mistrust and non-cooperation. Other sources of conflict included timber, valuable non-timber products like gaharu or birds' nests, and land containing coal deposits. Every village experienced however its own unique constellation of specific conflicts (Table 7.1). A general pattern can be seen among the different parts of the watershed. In the far reaches of the upper Malinau, where mostly Punan groups lived, conflict focused on access to forest products, in addition to the sources mentioned above. In the central portion of the upper Malinau, where rich coal deposits occurred, conflicts emerged because of efforts to claim compensation from the coal mining company for the use of cultivated or fallow fields. In the lower stretches of the upper Malinau, problems focused only on access to agricultural lands and historically problematic relationships of mistrust.

Underlying the mistrust and lack of cooperation were disparities in economic or political status between villages. These disparities affected how a conflict over boundaries manifested itself, as well as the possibilities for resolving the conflict. As we discuss further below, the larger the discrepancies between villages, the less likely it was that villages were able to reach agreement about boundaries.

Although many of these conflicts had existed formerly, villagers noted that the intensity of the conflict increased with the advent of outside parties seeking to exploit local resources such as timber and coal and offering compensation payments for them. The possibility of earning large amounts of extra income raised the stakes of the conflict, and made people determined to protect or expand their claims to timber or coal-bearing areas. When high stakes occurred, more latent, long-term conflicts related to intervillage differences or rights to agricultural land

Table 7.1 Sources of conflict affecting boundary negotiations

Boundary	Source of conflict				
	Coal deposits	Agricultural lands[1]	Non-timber forest products[2]	Timber	History of poor relations
Lidung Keminci - Sentaban		X			X
Sentaban - Setulang		X			X
Setulang - Setarap		X			
Setarap - Batu Kajang		X			
Batu Kajang - Gong Solok		X			X
Batu Kajang - Adiu					
Gong Solok - Adiu		X			X
Adiu - Loreh		X		X	
Adiu - Nunuk Tanah Kibang					
Long Loreh - Gong solok					
Long Loreh - Nunuk Tanah Kibang					
Long Loreh - Langap	X	X	X		X
Langap - Seturan/Punan Rian	X	X	X		X
Langap - Nunuk Tanah Kibang	X	X			X
Langap - Laban Nyarit	X	X			
Langap - Tanjung Nanga'	X	X			X
Laban Nyarit - Mirau		X	X		
Laban Nyarit - Halanga'		X			X
Laban Nyarit -Tanjung Nanga'	X	X			X
Laban Nyarit - Metut					
Laban Nyarit - Pelancau					
Laban Nyarit - Long Lake					
Tanjung Nanga' - Seturan					
Tanjung Nanga' - Metut		X		X	
Metut - Pelancau		X	X	X	X
Pelancau - Long Lake					X
Long Lake - Long Jalan			X		X
	6	17	5	3	13

[1] Swidden fields, rice fields, perennial gardens

[2] Birds' nests, gaharu etc.

were drawn to the fore and further fuelled the intensity of the immediate conflict.

The Process of Negotiation

Community Participation

Community participation in the negotiation and mapping process was lower than CIFOR anticipated. It was also less than necessary for the mapping to genuinely reflect diverse villagers' interests. In retrospect, however, we found that low participation is common in participatory mapping (Fox in press) and generating adequate participation is a central challenge of populist approaches (Rossi 1997). In Malinau, we observed that the lack of broad participation or at least effective representation in the negotiations in particular affected the ability of villages to achieve stable agreements. Although villagers asked us to conduct the mapping during a period of low agricultural activity (April to July) so that they would have more time available, and CIFOR's Core Team actively sought to stimulate broad community participation through meetings and informal interaction, decisions tended to be controlled by only a few individuals. We observed this decision-making pattern to be typical in villages of the upper

Malinau River for most matters at the village or intervillage level.

In relation to mapping, participation was ineffective both within villages as well as in meetings between two or more villages. Within villages, participation in meetings was low. For example, in the Loreh site (four villages) only 50 people of a total of over 1000 ever attended most public village meetings, including the mapping consultations. Only 20 people from the Loreh villages were later involved in the final negotiation with Langap. Of the 60 people interviewed in the Loreh villages after the mapping had been completed, only a small proportion knew that the mapping took place. Factions were common in even small villages. Representatives of these factions were frequently not present in meetings, either because they had not been invited or they purposely did not attend. Boycotts of meetings were a common means of quiet protest against the group calling the meeting. Village leaders usually only consulted with a small circle of influential colleagues among the *tokoh masyarakat* and never actively sought the views of different groups, let alone represent them. Women rarely participated in meetings, and if they did, rarely spoke. Predictably, village politics led to some groups giving more weight to their own preferences, while marginalizing others.

In intervillage meetings, villages were represented by only one to six influential village members (*tokoh maysarakat*), including among others the village head (*kepala desa*), members of his staff (*aparat desa*) and customary leaders. Even though there were village leaders representing villages, decisions often could not be reached if a key leader was absent. In Langap, for example, a decision could not be taken without the endorsement of the Merap customary leader or *kepala adat besar*. In Metut, the absence of the village secretary completely stalled negotiations with Pelancau. In cases where the village leader only needed to reaffirm an existing agreement, the participation of a few individuals was sufficient for ensuring acceptability to other villagers and the stability of the decision. A small delegation became problematic, though, where changes needed to be negotiated and consultations with key influential people and representatives of groups were needed before settling on a particular option on behalf of the village. People attending meetings on behalf of a village rarely reported back to the village about the outcome of their negotiations.

One of the most important factors affecting participation was the location of a meeting. The number of people attending a meeting was strongly affected by its location in one village versus another. Time and transportation expenses limited the number of people willing to travel. For example, a meeting between Langap and its neighbours held in Langap involved 21 members of Langap and none to three members of the eight neighbouring villages. Similarly in a meeting held in Setulang, 30 people attended from Setulang, compared to the three from the neighbouring village of Setarap. If negotiations are held repeatedly in the same village, other villages face difficulties in sending representatives, which then compromises their ability to reach more stable decisions.

Representation and participation among the Punan was especially poor. The Punan faced special constraints participating in meetings called in villages. First, Punan families frequently went to the forest for long periods of time (*mufut*), with men additionally going into the forest to look for gaharu (*Aquilaria* sp.) for weeks or months at a time (*ngusah*). Their absence meant that they also would often not know about meetings in advance and therefore lacked time to consult with other community members before attending a meeting. Second, where the Punan lived in a settlement with other ethnic groups, the Punan did not always feel comfortable expressing themselves in meetings. More dominant groups did not always invite them to meetings and information from meetings was not always shared with them. Selection of representatives to meetings appeared to be more *ad hoc,* and these representatives were rarely accountable to anyone in the village. Among the nine locations where Punan villages coexisted with other ethnic groups, participation of Punan groups was extremely weak in three communities (Seturan-Punan Rian, Tanjung Nanga'-Respen, and Gong Solok I and II). Third, in at least Langap, the Punan living in neighbouring Long Rat and Punan Rian had a historically subservient relationship with the Merap, having been given land locally to facilitate their work as forest collectors for the Merap, especially of birds' nests. A final reason for weak Punan participation was that in four settlements (Pelancau, Long Lake, Metut and Long Jalan), members of the village were scattered in several locations, making it difficult to involve representatives from all groups and distribute information to everyone.

Internal village processes

Internal village consultations strongly affected the ability of villages to reach agreement among themselves, as well as with other villages. In each case, the village head (*kepala desa)* coordinated whether these consultations occurred or not, sometimes together with the customary village head (*kepala adat*). Of seven pairs of villages that engaged in broad consultations within their respective villages before negotiating with their neighbours (Setarap-Setulang, Setarap-Batu Kajang, Batu Kajang-Gong Solok, Tanjung Nanga'-Langap, Langap-Laban Nyarit, Langap-Loreh, Metut-Pelancau), five resulted in agreements. Internal preparations served the purpose of ensuring that the negotiated decision would be acceptable to the broader community. They also helped community representatives to explore different options and have more information at hand to be able to negotiate better. These preparations differed among villages. Only 11 out of 27 villages held formal community consultations or *musyawarah*. Others held small informal meetings. Aspects of internal consultations that seemed most important in producing a stable, broadly acceptable outcome were as follows:

- Transparency, indicated by the holding of a community meeting attended by a majority of the families. Where transparency was lacking (e.g. Metut, Sentaban and Laban Nyarit), people within the village later challenged the agreement determined by the village head.
- Community capacity to work together and trust and support each other (community cohesion), indicated by a history of lack of factionalism, cooperative efforts at the village level and support for the village leader. Such capacity was high, for example in Tanjung Nanga' and Setulang. Where people did not work together, negotiations were less effective. Langap representatives negotiated demands from Tanjung Nanga' that were not supported by other Langap villagers (where at least four factions exist), such that when the mapping team tried to identify boundaries, the agreement was rejected.

Negotiations between villages

In observing the negotiation process, we sought to understand how negotiations were organized and the factors influencing their outcome. Although we

People were often eager to mark their boundaries, especially along a road

initially encouraged parties to reach agreement[18] quickly and described this as a 'successful' negotiation, we soon learned that many such agreements were short-lived and partial in their support. An agreement reached quickly enabled communities to conduct the mapping of their territory, but we fear this occurred too often at the expense of a more socially inclusive process that would have probably resulted in more stable results. We learned that *we should have evaluated the process underlying how a village reached their agreement as a basis for proceeding with the mapping, not just whether an agreement had been reached.*

Two approaches were used in negotiations between villages: meetings between village heads or meetings between selected village representatives. Meetings between village heads usually occurred where there had been no previous village consultation. As noted above, this occurred in several cases where both parties already accepted a boundary and the boundary only required affirmation (Laban Nyarit-Pelancau, Laban Nyarit-Metut, Laban Nyarit-Long Lake). In these cases one meeting was sufficient to agree on boundaries. Where there was a disagreement about the boundary, however, community members consistently rejected agreements reached only by their village heads. For most villages, negotiations with other villages commonly involved one to five meetings, although in one case 19 meetings were held! As noted above, both village heads and other representatives were only partly, if at all, accountable to their broader village constituency.

In the negotiation process, five factors appeared to help communities reach agreements, in addition to the influences mentioned above. First was consultation with the other village. Among the 27 villages, eight held consultative *musyawarah* meetings with neighbouring villages as part of their preparation for the mapping. Six of these villages successfully negotiated agreements. Good relations did not predispose these villages to having meetings and reaching agreements, since at least half of the six were communities with long-standing historical difficulties with their neighbours.

Second, family relations among villages encouraged compromise that led to more rapid agreement. Six villages (Long Jalan, Long Lake, Pelancau, Metut, Laban Nyarit, Langap) sought agreements based on compromises because of family relationships with another village. Although they may have wished to expand their territory due to the changing value of resources, because they were all members of the same extended family, these communities decided to maintain existing boundaries.

Third, financial incentives encouraged speedy resolution. Potential compensation payments by the coal company or sharing of benefits from small scale timber harvesting (IPPK) holders promised concrete benefits that encouraged villages to act quickly to reach agreement and get on with mapping their lands to secure additional income. With the uncertainty of decentralization policies, a first-come, first-served attitude developed where people feared someone else would benefit from the resource if they did not make use of it first, or the policy would change and the benefits would no longer be available.

Fourth, villages with similar institutional capacities and power were more likely to reach agreements than villages that differed.[19] In a number of cases, especially the case of Langap and its weaker neighbours such as Long Rat or Paya Seturan, more powerful villages presumed themselves entitled to exert their will about a boundary decision, and disregarded the need to build agreement with a weaker village. Weaker villages often passively resisted these decisions by the more aggressive villages. This pattern is evident with the application of a simple scoring system,[20] the results of which are summarized in Table 7.2. Even where agreements were ostensibly reached, there was a clear pattern that villages having lower capacity-power differentials were more likely to reach stable agreements. The more similar two villages were, the more likely they would not challenge boundary agreements.

The fifth factor influencing outcomes was the opportunity to share benefits across villages. CIFOR assisted villages to reach agreement in several cases by encouraging villagers to treat the boundary not as a fence excluding non-villagers, but as a set of rules about sharing access or benefits. In seven cases (meaning the unique boundary between two villages), villages negotiated agreements enabling neighbours to maintain their swidden fields, perennial gardens, or hunting rights (Langap-Loreh, Langap-Seturan/ Punan Rian, Langap-Nunuk Tanah Kibang, Langap-Laban Nyarit, Laban Nyarit-Tanjung Nanga', Metut-Pelancau, Long Lake-Long Jalan). In five of these cases agreements were reached. Langap and Nunuk

Table 7.2 Difference in capacities and power status between two negotiating villages and nature of agreements reached

Difference in capacities and power status between two negotiating villages	Difference in capacity-power scores	Agreement reached?		Stability of decision[1]	
		No	Yes	Stable	Not stable
No difference	0	0	6	5	1
	0.5	1	7	6	1
Moderate difference	1	2	2	1	1
	1.5	1	5	2	3
Large difference	2	1	1	0	1

[1] Stability was only counted for cases where agreement was reached.

Tanah Kibang agreed to share future compensation payments from the coal company. Langap and Long Loreh reached agreement about an area under which lay valuable coal, by acknowledging that Loreh could continue to use existing cultivated plots in the Langap territory. Although both parties appeared satisfied with the current arrangement, there was no discussion of who would gain rights to compensation payments should these agricultural plots be converted for mining. In negotiating these agreements, village decision makers had to carefully weigh the benefits of working out an agreement in highly specific detail against working out only the broad principles. Negotiating too many details creates the risk that agreement would not be achieved. Negotiating only general points enables at least a partial agreement to be achieved—but at the risk that additional conflict will occur later.

To the extent these factors were not present, villages with conflicting boundary claims were not able to reach agreement. These villages were ultimately not able to sustain a supportive political base. We observed in particular that community members in these villages frequently did not support agreements produced by their leaders and in several villages refused to map the suggested boundary. For two villages, there was also the practical problem that they were not sure whose territory adjoined their own because their borders were far, hence their preparations with these neighbours were lacking and preliminary agreements had to be renegotiated (Gong Solok-Long Loreh, Batu Kajang-Adiu).

The Results of Negotiation: Boundary Agreements

Of the 27 boundaries among villages in the upper Malinau, 21 were negotiated to the point of agreement between the villages concerned during the seven-month period during which CIFOR conducted the mapping (Table 7.3).

During the period of the mapping, most villages relied on written agreements between villages, which for many was a new development. Verbal agreements had previously been more common for boundaries. Written agreements were produced as *berita acara,* or public announcements signed by two parties and sometimes further signed by the local subdistrict leader (*camat*). Although in the past, some community leaders amended documents to include extra signatures from another group, it appears that the *berita acara* produced during the mapping process were legitimate. In the past, one village in particular had attached the signatures from attendance at a meeting to a statement of supposed agreement and produced a map showing their own version of the boundary. Trust in written agreements appears to be increasing despite such past abuses. Trust in verbal agreements has certainly declined, perhaps because they are seen as no longer binding and less legitimate.

Negotiations conducted transparently with written agreements tended to be more stable than those that were not. Of 21 boundary agreements, 14 were stable, while seven changed within the seven-month period. The 14 stable ones used more

Table 7.3 Results of Boundary Negotiations among Villages of the Upper Malinau River

Village boundary	Agreement reached	Documented in writing	Agreement stable[1]
Lidung Keminci - Sentaban			
Sentaban - Setulang		X	
Setulang - Setarap			
Setarap - Batu Kajang	X	X	X
Batu Kajang - Gong Solok	X	X	
Batu Kajang - Adiu	X		
Gong Solok - Adiu	X	X	X
Adiu - Loreh	X	X	X
Adiu - Nunuk Tanah Kibang	X		X
Long Loreh - Gong Solok	X		
Long Loreh - N.T. Kibang	X		X
Long Loreh - Langap	X	X	X
Langap - Seturan/P.Rian	X	X	
Langap - Nunuk Tanah Kibang	X	X	X
Langap - Laban Nyarit	X	X	X
Langap - Tanjung Nanga'	X	X	
Laban Nyarit - Mirau	X		
Laban Nyarit - Halanga'			
Laban Nyarit -Tanjung Nanga'			
Laban Nyarit - Metut	X	X	X
Laban Nyarit - Pelancau	X	X	X
Laban Nyarit - Long Lake	X	X	X
Tanjung Nanga' - Seturan	X		X
Tanjung Nanga' - Metut	X		
Metut - Pelancau		X	
Pelancau - Long Lake	X	X	X
Long Lake - Long Jalan	X		X

[1]Stability means here that there were no challenges to the agreed boundary by the two villages involved by July 2000.

transparent negotiation (negotiations that were conducted in a more secretive manner where negotiators did not share information about the process or contents of their meetings were Setulang-Setarap, Batu Kajang-Adiu, Long Loreh-Gong Solok, Laban Nyarit-Mirau, and Tanjung Nanga'-Metut) and ten of the 14 used written agreements.

However, as of December 2000, *nearly all villages requested changes even to previously stable boundaries*. We attribute these demands to the increasing activity of the small scale timber permit (IPPK) holders during the latter half of 2000 and a new provision at the provincial level enabling villages to claim compensation from timber companies for timber previously harvested. As the stakes rose, villages sought to increase their land claims even further. The lack of a clear higher third party institution with the authority to provide formal recognition of boundaries and control *ad hoc* revisions also made it possible for this fluidity to occur. With decentralization, just where this authority lies is not clear, although many have assumed it is

now with the *kabupaten.* The establishment of the new Malinau *kabupaten* has delayed the local government's involvement in the boundary demarcation to date. As the *kabupaten* asserts its authority and endorses boundary agreements, we can expect to see more stable results. The authority vested in this higher institution would have to be controlled by checks and balances and maintain downward accountability to ensure just decisions.

Impacts of Mapping

Viewed in November 2001, more than one year after the completion of the mapping, several important impacts of the negotiation process and mapping activity can be observed. First, a new awareness has emerged among all stakeholder groups of the location and extent of different villages, as well as the value of mapping as a means for making claims to land. This awareness can be considered a necessary basis for coordinated landscape management. Although CIFOR did not distribute maps of a village to others and clearly marked maps as drafts, villagers themselves often shared them (especially with local investors) and CIFOR displayed the maps in several meetings with other stakeholders.

New types of boundaries emerged as some villages (e.g. Tanjung Nanga' and Langap) reconceptualised boundaries as straight lines or along roads rather than natural boundaries. For most groups, there is a subtle shift in the conceptualisation of territory as defined by its centre settlement point or a main river of a watershed to an emphasis on outer boundaries. For some groups, especially the Punan, we suspect that the mapping has reinforced the historical trend of gradual territorialisation of previously nomadic or shifting groups, a trend accompanied by an increasing tendency among inland groups to want to register their land as property, and even to seek private rather than communal property. Whether such changes are significant and occur to the benefit or detriment of Malinau's populations and forest, it is too early to tell, but they do signal changing attitudes and values related to land. Developments in the policy environment related to *adat* and IPPK claims will strongly influence how these changes play out.

Second, the mapping process, in combination with other changes related to decentralization and changing attitudes towards land, affected relationships among and within villages. The mapping brought out conflicts that had been latent, thereby exacerbating conflicts in some villages and alleviating it in others through negotiations. New alliances and coalitions among communities emerged as weaker communities sometimes conferred among themselves about how to deal with a common, more powerful, community. For five pairs of villages we observed improved relationships after boundaries were settled. For five others, relationships declined, and for the remainder relationships stayed more or less the same. Where there were multiple villages in one site (e.g., the sites of Gong Solok, Long Loreh and Sentaban), financial offers from investors arriving after the maps were completed contributed to the villages in each location wanting to have separate territories, resulting in more antagonistic relationships among villages in the location.

Within communities, we saw five communities where new factions emerged as a result of the mapping, despite these particular villages having relatively strong leadership, community cohesiveness and good access to information. Three of these occurred because a faction did not accept the decision handed down by the village leader. Two occurred because of a subgroup of the village wanting to make claims for themselves, e.g., Liu Mahan in Long Loreh, and the case of Laban Nyarit and Halanga'. As attitudes and values about land changed, so did village relationships. There was no significant overall trend, however, towards better or worse relationships.

Third, community capacities for mapping and negotiation improved. Small teams of people in each community mapped gained experience in the methods and equipment necessary to geographically reference and plot a series of point in their village on a map. Understanding of maps—including scales, legends, orientation and their uses—became stronger in each village. Through the process of negotiation and with input from CIFOR, communities' understanding of representation and the need for building a wider political base of support for reaching an acceptable agreement also increased.[21] Since the project began, there have been more demands from villagers for their leaders to use more transparent, inclusive processes for consultations and decision making.

We report observations about the participatory mapping process in Attachment 2.

Conclusions

What did the Malinau experience in boundary demarcation indicate about the kinds of conditions necessary to facilitate better coordination with other stakeholders and improved negotiations by communities? What do they add to our understanding of emerging principles related to multistakeholder processes? We summarize our observations below and draw conclusions about the lessons that seem most generalizable to other settings.

Facilitating coordination requires handling political factors

Boundary negotiations in Malinau highlighted the deeply political nature of coordination efforts and the skewedness of power relations underlying them, even among seemingly (to an outsider) homogenous community groups. Portraying the agreement-seeking process as apolitical or neutral would ignore fundamental relationships that our experience showed influenced *whether agreements were reached, how resources were distributed in agreements,* and *the stability of outcomes.* Political aspects of coordination that we noticed to be especially important in Malinau were *how conflicts were defined* (e.g. history of mistrust between villages), *the differences in capacity and power status* among villages that made agreements hard to reach or less stable, and *the lack of representation and attention to weaker or more marginalized groups in negotiations.*

Dealing with fluidity

As political struggles in Malinau played themselves out through shifts in alliances, stakes and negotiating conditions, people's interests, agreements reached and coordination efforts tended to change frequently. Our experiences support the pluralists' position that *agreements are best thought of as partial and temporary,* and we observed such fluidity to be extreme in Malinau. We conclude from our three years of study that *the more intense the underlying struggle, the more fluid interests, agreements and coordination* are likely to be. In Malinau, periodic opportunities to claim resources—as with the event of decentralization, the changing monetary value of local resources, the new *kabupaten* and the mapping activity—directly caused struggles to increase. Reaching stable decisions may have sometimes been actively avoided by villagers in part because of a lack of knowledge of an appropriate 'solution' given the rapidly changing conditions.

Facilitators of multistakeholder processes should anticipate fluidity and adjust coordination practices to accommodate it. In hindsight, the instability of boundary agreements in Malinau that were reached before July 2000 was predictable. During periods of fluidity, instead of investing in formalizing and implementing agreements likely to change, it might be more useful to anticipate increased conflict and seek only tentative agreements that require a testing period of several months or longer, depending on the volatility of opportunities and the extent to which agreements are likely to be challenged. In this way, vague arrangements (e.g. Loreh-Langap) resulting from efforts to achieve agreements quickly could be tested for their loopholes. During such periods, a focus on *managing conflict* to maintain constructive levels of debate is likely to be more productive than forcing an agreement. Also, as the concept and practice of agreements appear to be evolving and becoming more formalized, villagers may need time to develop a shared understanding of what such agreements are and imply. Investment in implementing the agreement could occur after evidence of reasonable stability.

Although some fluidity is inevitable and facilitators should manage it to adapt to changing forest conditions and managing political tensions, the extreme fluidity witnessed in Malinau imposed high costs on everyone. Agreements reached quickly were not necessarily fair or acceptable to the people concerned. Groups—including CIFOR—that invested time to carefully negotiate boundaries and then engaged in the tedious process of mapping, felt frustrated when these agreements were later changed. We observed that there is a need for facilitators and participants in negotiations to *build a supportive political constituency through consultation, and transparent decision making appeared to be key to achieving and then keeping an agreement.* Building such a constituency requires adequate time and deliberation. In addition to building support from the bottom, we think authority from the top can also stem extreme fluidity. The challenges to agreements in Malinau would have most likely been fewer if a third party with authority and legitimacy above the level of the village level had been involved to set the criteria

for resolving conflicts and validate and enforce legitimate agreements. Coordination processes may therefore need *to take both bottom-up and top-down measures to balance the need to flexibly respond to fluid conditions against seeking to limit excessive change that imposes excessive costs.* Such top-down measures probably need to include *kabupatens* making use of provincial and national policies and agencies to reinforce local decisions.

Complexity of conflict

The political nature of agreements and negotiation also suggests the need to consider *power relationships in understanding the complexity of conflicts.* In Malinau, conflicts over village boundaries involved multiple dimensions of historical, ethnic, class and economic relationships among and within villages. Boundaries were not just lines on maps, but major determinants of monetary flows and resource use to villages and individuals within them. Profound changes in people's attitudes towards land and its values created new dimensions of struggle related to speculation.

Our observations in Malinau suggest that it is indeed impossible to ever really know other people's interests, as leaders covertly negotiated among themselves and changed their minds about previous agreements. Instead, to better understand the factors driving negotiation, we suggest that an understanding of the diverse political relationships among groups can facilitate coordination and negotiation. Such an understanding is particularly important for promoting coordination and negotiation that deals fairly with differences in power among stakeholder groups. With such information, *facilitators of negotiation can better select representatives, fora for decision making, and subjects of negotiation that deal with the different aspects of the conflict.* They should *use a phased process that allows layers of conflict and awareness of changing political conditions to unfold and be identified.* An open framework of conflict management and flexible schedule is needed to allow for new elements of conflict or new authorities to be incorporated.

Accountable decision making

In Malinau, only a handful of people tended to be involved in each village in negotiating boundary decisions and these representatives, if the label is even apt, were weakly, if at all, accountable to their communities. Networks, communication and trust were frequently strong among selected leaders, or between leaders and companies, but often less strong between leaders and their constituencies. Decisions were usually made without consultation. A number of villages attempted to map their boundaries without even consulting their neighbours. These conditions made it difficult for conflict to be managed in transparent ways, which kept disagreements from being acknowledged and agreements from being implemented.

Abuses of power are likely to persist unless certain checks are put in place. Central among these checks is the need for better representation and transparent decision making to negotiate decisions that constituencies will accept and support. Where community representatives were more accountable to their constituencies and built a strong political base of support, decisions were less frequently challenged. *Broader consultation with factions in communities and better reporting back to communities can assist with building transparency*. *Leaders need to be more downwardly accountable to their constituency* to create incentives for them to be more responsive to community interests, although this would be difficult to fully implement in groups like the Kenyah and Merap due to a strong tradition of hierarchical control by the aristocratic class. Interlocking family, ethnic and economic relationships would help to foster agreements, but could work to marginalize outgroups and encourage corruption. In Malinau, the history of upward accountability of government representatives, the hierarchical nature of customary leaders, strong local networks and the pressures for striking quick deals have led to regular abuses of power that will not change easily. The more open environment of the post-Soeharto reform era creates the opportunity to question these networks, but changing how they work is a much more ambitious task.

Improving involvement of disadvantaged groups

Conventional multistakeholder theory seeks to establish neutral conditions that enable fair negotiation. We agree that s*pecial effort is needed to encourage effective participation and representation of weaker or disadvantaged groups.* Historical

information and analysis of the multiple aspects of conflict will help to indicate who is most disadvantaged. We would add, however, as argued in Edmunds and Wollenberg (2001), that *political relationships pervasively influence even so-called neutral processes and should be dealt with explicitly throughout the coordination process*. In Malinau, *differences between villages in capacity and power status affected nearly all aspects of negotiation*, including how the conflict was defined and who defined them. We suggest that at a minimum, facilitators of coordination efforts pay attention to these differences and seek to give certain advantages to weaker groups. These include, for example, distributing information to them earlier, giving them priority access to resources, and facilitating their preparations for negotiations. More significant measures for longer-term empowerment would include community organizing, assisting them to mobilize resources and helping them develop strategic alliances.

All of this depends of course on the desire of the group in question to receive such extra attention, and facilitators should take care not to create an identity of disadvantage that prevents the group in question from seeking to empower themselves. Facilitators also need to take care not to alienate more powerful groups in the process by creating unfair advantages or overprotecting the group in question.

Legitimacy: Effective coordination requires shared operating principles

Participants in a coordination process, with the assistance of outside parties, should periodically assess the legitimacy of any process of negotiation, agreement making or coordination to identify how well accountability measures and attention to disadvantaged groups are working. Given the nature of ongoing struggles and highly unequal power relationships in places like Malinau, the potential for abuses of power in multistakeholder coordination processes is high. Such abuse can cause existing conflicts to escalate, particularly under the conditions of greater openness enjoyed now in Indonesia, and result in protests involving disruption of work, degradation of forest resources, and destruction of property, as has already been demonstrated in Malinau.

There is thus a need to build coordination upon stronger social foundations about what are considered legitimate operating principles and outcomes. In Malinau, there is presently an institutional gap, such that there are no clear authorities on either the customary or the government side for settling conflicts among stakeholders in ways considered legitimate by all groups. Some groups are presently seeking to build that legitimacy, especially the *kabupaten* government, by, for example, creating new sets of local regulations about customary land claims. Following pluralist principles, they have been seeking in 2001 to better accommodate other authorities, including customary leaders. However, because of the close relationships between many of the government officials and local customary leaders, self-interest appears to prevail even here. Ultimately there may be a need for a consortium involving outside groups with few local relationships. The consortium would facilitate debate and develop and articulate the shared operating principles, as well as identify who should best act as the authority for implementing and enforcing the principles. Even within this consortium though, there would need to be vigilant attention to the nature of operating principles as something negotiated and subject to abuse by more powerful parties.

Participatory Mapping as a Tool for Achieving Coordination

Participatory mapping is, in theory, one approach for building a strong bottom-up political base of support for demarcating boundaries. It also, in theory, should build local capacities and empower groups that would not normally be involved in such processes to better understand maps and the types of decisions involved in mapping. While we agree that boundary demarcation is an essential tool for achieving bottom-up coordination and builds capacities, we note some differences between our experience and that in the literature.

Most documentation of participatory mapping focuses on the technical aspects of the process and its outcomes (Momberg *et al.* 1996, Gupta and IDS Workshop 1989) with little, if any, attention to the negotiation process underlying decisions or the acceptability and stability of outcomes (exceptions being Fox 1998, Peluso 1995). More attention needs to be given to the limits of making such processes

truly participatory (see Fox, in press), identifying appropriate stakeholders, developing operating principles for negotiation and identifying institutions for settling conflicts and legitimising outcomes. Bottom-up approaches alone will not work if there is a need for an authority at a higher level to resolve conflicts or support agreements. The factors that led to stable, accepted outcomes should be noted to assist others in seeking to replicate these conditions. As highlighted throughout this report, more effort needs to be given to making processes more fair for disadvantaged groups by giving them extra attention in training, working with their schedules, holding meetings in places convenient for them and enabling negotiations that acknowledge differences in power.

Experience in Malinau and elsewhere suggests that such deliberative and pluralistic coordination can be achieved through meaningful consultation among affected groups, accountable representation, fair negotiation, transparent decision making, public reporting and safeguards for effective representation of disadvantaged groups. Agreements among parties should be recognized as partial and temporary, with attention given to understanding not only how to reach agreements, but also on how to manage the conflicts resulting from the evolving interests of each group.

In conclusion, our experience in facilitating boundary demarcation in Malinau marked only the beginning of a long and multistranded process for achieving better coordination among the very diverse stakeholders interested in Malinau's forests. The research demonstrated the nature of coordination and agreement making in Malinau and its current vulnerabilities. The base of political support for coordination is fluid and often fragile. There are few safeguards to ensure fair negotiations for weaker groups. The authorities for supporting and endorsing these processes are unclear. Very real gains have been made, however, in empowering local communities to begin the process of asserting claims to their territories and of establishing debate about rights associated with those claims. A process has been started that communities, government and companies are now keen to complete. Further efforts at coordination will hopefully heed the lessons of this experience, and in the process generate its own local brand of democracy that enables the people of Malinau to embark upon the exciting journey that lies ahead.

Endnotes

[1] The project was conducted by the following members of the Bulungan Adaptive Co-Management Team and Core Mapping Team from 1998–2000: Salmon Alfarisi, Sargius Anye, Njau Anau, Ramses Iwan, Pajar Gumelar, Miriam van Heist, Godwin Limberg, Made Sudana, Nyoman Wigunaya, Asung Uluk, Lini Wollenberg. We wish to express our thanks to and acknowledge the support of the following parties: the local government of Malinau District; Roem Topatimasing and INSIST; Carol Colfer, Kuswata Kartawinata, Steve Rhee, David Edmunds, Yurdi Yasmi and Herwasono Soedjito from CIFOR; Jalong Lawai, and Paulus Irang of Long Loreh; Samuel ST Padan and WWF-Kalimantan Action Network; WWF-Kayan Mentarang; Ade Cahyat and Konsortium Sistem Hutan Kerakyatan-Kaltim; Niel Makanuddin and Plasma; Franky and Yayasan Tanah Merdeka; Amin Jafar and Yayasan Padi; H. Sayo and Pemberdayaan Pengelolaan Sumber daya Alam Kerakyatan; Mairaji and Lembaga Pemberdayaan Masyarakat Adat; and Jon Corbett and the University of Victoria. The work was jointly funded by ITTO (primary donor) and the International Fund for Agricultural Development.

[2] Coordination refers here to decisions that seek to achieve an aim on behalf of a group in light of the many self-interests of individuals that exist in that group. Coordination can be self-organized (Ostrom 1999, DiZerega 2000) or imposed from outside the group. We assume here that coordination is likely to be more successful where it can balance self-determination by group members with institutions at the group or supragroup level that maintain authority and legitimacy to make and enforce decisions on behalf of the group.

[3] We use Rossi's (1997) interpretation of deliberative here, meaning dialog and discussion that operates in an 'engaged mode, somewhere between mere respect and confrontation,' (p 205), and deliberative democratic decision making, in which individuals seek to go beyond their self-interest (although such interests might be part of the dialog), and make decisions based on their perception of the common good.

[4] Sections of this report are drawn from the CIFOR report '*Pemetaan Desa Partisipatif sebagai alat menyelesaian konflik: Studi kasus desa-desa daerah aliran Sungai Malinau, Januari s/d Juli 2000*, *Tim Pengelolaan Hutan Bersama secara Adaptif,* 2001.

[5] These recommendations are drawn from Edmunds and Wollenberg 2001 and Wollenberg *et al.* 2001, the latter of which is a synthesis of other papers (see References).

[6] The *Kabupaten* has recently expressed an interest in learning more about scenario methods.

[7] License to fell and utilize timber.

[8] Funded by ACIAR.

[9] Fox (in press) characterizes overlapping sovereignties in late 1800s Thailand, writing that sovereignties were 'neither single nor exclusive' (p. 2), but rather (citing Winichakul 1994: 88) 'capable of being shared—one for its own ruler and one for its overlord—not in terms of a divided sovereignty but rather a sovereignty of hierarchical layers.'

[10] Interestingly, the letters of tax payment have been used in more modern times to establish ownership over the caves.

[11] According to Sellato (in press) Dutch control in the Bulungan Sultanate began in 1850 with a *Politiek* Contract, was furthered in 1877 with an agreement for the Dutch to handle some of the sultanate's affairs and formalized in the late 1880s as part of the Dutch colony. In the early 1900s they forced the Sultan to turn over control of the remoter regions of the Bahau River, Pujungan River and Apo Kayan. They also worked with the sultanate, for example to put down a Dayak rebellion in 1909 in the Tidung lands (includes the current Malinau River area).

[12] According to Sellato (in press), in 1950 Bulungan became a *Wilayah Swapraja* (Autonomous Territory, 1950) of Indonesia after the Japanese occupation, and then in 1955, a *Wilayah Istimewa* (Special Territory). In 1959, after the last sultan, Jalaluddin, had died in 1958, the sultanates were abolished and Bulungan became an ordinary regency (*Daerah Tingkat II or kabupaten)*.

[13] Prior to the Merap, it is believed that the Berusu' and Punan occupied the area (Sellato in press, Kaskija 2000).

[14] Even though demands for compensation had been made previously, villagers received few, if any, benefits in response.

[15] The young *kabupaten* has so far had two *bupatis*; Bapak Asmuni Alie served as a temporary *bupati* and issued all of the 38 IPPKs now functional in Malinau. In March 2001, he was replaced by Bapak Marthin Billa, a forward-thinking leader who helped to first establish the '*tanah ulen*' concept with WWF in Kayan Mentarang in the mid-1990s.

[16] This is not to imply that conditions before decentralization were always lawful or fair. There are numerous examples of smaller scale illegal logging and other illicit and unfair activities from the pre-reform era.

[17] Historically they have lacked the strong social cohesion of groups like the Kenyah or Lundaye and have lacked effective institutions for representing their interests. Only in the mid-1990s did the Punan in Malinau organize the appointment of a Punan customary leader.

[18] We defined agreement as concurrence between two villages about the location of their boundary.

[19] We used *strength of leadership* (economic status of leader, e.g. food surpluses, quality of home construction, access to significant or regular cash income, possession of productive assets like rice mills or luxury items like parabolas; alliances with powerful external groups; support of leader by community and level of leader's education), *cohesiveness of community* (economic status of community, e.g. see above; internal loyalties and mutual supportiveness; alliances with powerful external groups; skills and education levels; support of leader by community and level of leader's education) and *access to information* (transparency of mapping process within village, knowledge of their territory) as indicators of a village's institutional capacities and power.

[20] A score of 0, .5 or 1 was assigned for each of the three dimensions above. Attachment 1 summarizes the scores.

[21] This understanding increased among broader community members. Many community leaders were savvy enough to know, and decide when to use more (or as was usually the case, less) participatory approaches.

[22] Even at the time that this report was written, there are, however, conflicting interpretations of what '*wilayah desa*' or village area implies. Among villages, there was disagreement about whether to join, for example, all the village in one location in one area. Government authorities and local companies were not amenable to communities claiming areas within concessions and would prefer to see land reserved for exclusive government use (Marthin Billa, personal communication November 2001).

[23] We developed our approach based on the examples of participatory mapping conducted by the World Wide Fund for Nature in Kayan Mentarang and by several NGOs in West Kalimantan.

[24] As a response to IPPK developments, we did make an effort to increase attention to building community negotiation skills, hold multistakeholder dialogues and build community and government knowledge of decentralization laws, as well as to send a group of villagers on a cross-visit to oil palm estates in the Paser region of East Kalimantan.

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Attachment 1

Scores of village capacity and power status

Village	Leadership strength	Strength of community organisation	Information access	Village score
Sentaban	Lemah	Weak	Medium	0.5
Setulang	Medium	Strong	Strong	2.5
Setarap	Medium	Medium	Medium	1.5
Batu Kajang	Strong	Strong	Medium	2.5
Gong Solok	Weak	Weak	Medium	0.5
Adiu	Medium	Strong	Medium	2
Long Loreh	Weak	Medium	Strong	1.5
Langap	Weak	Weak	Strong	1
Seturan	Weak	Medium	Medium	1
Nunuk tanah kibang	Medium	Medium	Medium	1.5
Laban Nyarit	Strong	Medium	Weak	1.5
Mirau	Weak	Weak	Weak	0
Halanga’	Weak	Weak	Weak	0
Tanjung Nanga’	Strong	Strong	Medium	2.5
Metut	Weak	Medium	Medium	1
Pelancau	Medium	Medium	Medium	1.5
Long Lake	Medium	Medium	Medium	1.5
Long Jalan	Weak	Strong	Medium	1.5

Vilage score is calculated by the value of leadership strength, strength of community organisation, information access

Value: Weak = 0; Medium = 0.5; Strong = 1

Notes:

Leadership strength is measured by:

Economy

Outside relations

Support of community

Education

Strength of community organisation is measured by:

Ability to work together

Economy

Human resources

Outside relations

Information access is viewed by:

Knowledge of field

Information about mapping activities and results of meetings

Attachment 2

Observations about Participatory Mapping

Because participatory mapping by rural communities has become popular in recent years, we report here on the lessons we learned and what we think could be improved. Additional information about the technical aspects of the mapping can be found in Van Heist (2000).

Our most significant lesson was that it was extremely difficult to make participatory mapping truly participatory in the sense of village self-sufficiency in mapping. Participation was lacking in two regards—the proportion of the community involved in decisions about mapping and the degree of village capacity to conduct the mapping on their own. As noted, however, by Fox (in press), lack of community self-sufficiency in mapping is common in much participatory mapping and may be less important than who controls the maps in terms of its impact on empowering local communities. Also, as discussed above, the level of participation in the mapping exercises and related negotiations was not unusual compared to participation in other village level efforts. If communities or facilitators of projects wish to increase long-term mapping capacity, training exercises should occur over longer periods of time than the one to two weeks used by CIFOR. There should be careful selection of participants to identify qualified individuals and exercises should be repeated several times.

We feel the more important dimension of participation that requires attention is the need for community decision making to better engage its members in debate and discussion and to give more attention to the interests of its members. We observed a *general lack of adequate representation and accountability of leaders to their constituencies*. CIFOR's efforts to reach 27 villages with the funding and grant schedule given also meant that the *time to work with any one village to stimulate interest and build skills was constrained* by limited funds and the schedule of the grant. Where problems are expected with representation, more time should be allocated to working with villagers to engage more people directly.

CIFOR's core team found that they needed to take an active, facilitating role in nearly all phases of the process. Although we were least involved in the negotiation stage, there were even calls from communities for CIFOR to assist in that process. We suggest it is realistic for others attempting participatory mapping to assume that they will need to play a strong facilitating role. Care needs to be taken though to *facilitate in a manner sensitive to different communities members' interests and empowerment*. The risk in assuming the facilitator's role is that the purpose and results of the mapping reflect more of the facilitators' interests than that of the villagers. In CIFOR's case, for example, we would have preferred to focus on mapping forests to be sustainably managed, which would have involved more of an emphasis on institutions and rules. However, because we wanted to accommodate villagers' interests to empower them and build their ownership of the process, we agreed to focus on administrative boundaries.[22] Participation should not mean that villagers become mostly labourers to carry out the aims of the facilitator. Methods need to be built in for communities to be able to control the process and take responsibility for key decisions. In CIFOR's case, this meant that communities decided and negotiated their own boundaries, and rechecked and approved all maps.

Second, the mapping occurred during a time when the authority for determining criteria for boundaries, settling intervillage conflicts, approving boundaries and even the definition of a village itself were in transition. Since we started the process before decentralization policies were implemented and the new *kabupaten* established,[23] we had not anticipated these events and were unsure of how to adapt to them.[24] Consequently we found ourselves working with the status quo and assuming that existing claims by formally acknowledged villagers were legitimate. In retrospect, we should have probably *sought to engage communities and local authorities, even as they shifted, in more discussion about the basis for allocating land fairly in the watershed and what constituted a village, and to build this into the mapping process.* Having a firmer shared framework of criteria for determining what constituted a village or a village's legitimate boundary could have probably helped to settle conflicts and prevent the fluidity of boundary revisions and land claims that later occurred.

Because the authorities for settling these matters were themselves unclear or nascent and not as yet operational, it would have been difficult to create an effective framework within the time constraints of the project. As an intervillage affair, it

would not have been sufficient for villages themselves to determine the framework or for even an outside relatively neutral party such as CIFOR to play this role. Disagreements and changes of heart are inevitable, such that *a supravillage institution with the legitimacy and authority to make, validate and enforce decisions is necessary*. As an example, much debate occurred between adjacent newcomer villagers and older villages about the role of prior historical presence in establishing land claims (e.g. Setulang and Sentaban). Older villages tried to claim lands of newer villages for themselves. Although villages nominally agreed to not use history as a basis for land claims (supported by the urging of several government leaders), the lack of a clear statement endorsed by government authorities has encouraged older villages to persist in trying to expand their territories.

Third, related to the two first points, the *meaning of the maps produced was not always clear* to the communities or other stakeholders. We understood the maps to be of village administrative boundaries, with rights within those boundaries to be determined by other processes. However, despite numerous statements by CIFOR, INHUTANI II and government to the contrary, a number of communities considered the maps to be evidence of their ownership and control over the territories. Many communities therefore treated the completion of the mapping as an end in itself, rather than as a tool to be used for negotiating their rights with other parties. We discovered after the fact that some villagers even thought the mapping was intended primarily to service CIFOR's research projects. In hindsight, more intensive attention should have been given to developing a shared understanding of the mapping and use of the maps in the early stages of the project. In addition, we suggest that effective community-based mapping also requires higher scale social institutions and effective representation that can help to coordinate such understanding. Follow-up is necessary now to organize communities to work with local government to approve their boundaries and discuss associated rights, responsibilities and future land use.

A fourth lesson was that we should have *worked more strategically with a broader range of stakeholders* as policies and the social landscape evolved. In the effort to focus on community empowerment and build communities' trust, we worked primarily with communities and less with other stakeholders like local government and INHUTANI II in the early stages of the project. Local government was often seen as a force that had exacerbated rather than helped resolve conflict. Where local government had previously mediated conflicts, villagers commented that the outcome was determined by which side paid more to the official, rather than by a considered assessment of the situation.

Given the interests of these other groups in controlling communities' claims, we felt that the communities' own goals needed to be developed independently and that we needed to concentrate on building a solid relationship with communities. We expected communities to negotiate with these other parties at a later stage. Our experience suggests, however, that such empowerment activities can come at the expense of building relationships with other stakeholders. With more of the latter we might have lessened some of the suspicion other stakeholders had about our intentions and encouraged the development of the supravillage framework necessary for guiding land claims; however, this might have been at the cost of empowering communities.

Fifth, *good preparation and flexibility in schedules were necessary*. The mapping process proceeded smoothly in large part because CIFOR had invested in getting to know the communities since 1995. Villagers knew about CIFOR and had developed a certain level of trust in CIFOR. The Core Team also had very thorough preparation in developing their facilitation skills. Flexibility allowed us to adjust to villagers' own schedules. We completed the first phase of mapping in seven months, and even with that some villages had not yet resolved their boundaries while others decided to change boundaries previously mapped. The length of time was most drawn out by the need to settle conflicts about boundary location. The actual mapping was relatively quick. This suggests again that more adequate preparation in developing institutions and governance mechanisms to guide between-village decisions would have been helpful.

Sixth, as a technical note, in areas such as Malinau for which existing maps are generally poor, participatory mapping needs to give significant attention to producing a well-geo-referenced base map. In Malinau we did this through the use of satellite imagery and determining GPS coordinates at ground control points at major tributaries and other visible landmarks.

8. Research in Bulungan Model Forest: The Management of a Large, Multistakeholder Forest

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CIFOR's research in the Bulungan Model Forest within Kabupaten Malinau took the form of a systematic investigation into ways of achieving forest sustainability in a 'large forest landscape' with diverse, rapidly changing and often conflicting land use demands. The ultimate goal was to integrate the social, environmental, biodiversity and silvicultural aspects of the forest into a sustainable system of management that would benefit all stakeholders. In the dynamic, ethnically diverse setting of Malinau, CIFOR took a challenging approach to the research that emphasized the need to devise better methods for an iterative research process so that all the key players could participate in defining research priorities to address long-term forest management and sustainability.

The work proceeded along several complementary lines of research. This multi-element design demonstrated the value of developing a broad research programme where technical, institutional and economic factors could be assessed and combined successfully. Integrating the results from the different strands of the research allows a vital step to be made in developing a mutually comprehensible dialogue amongst stakeholders, in particular illustrating how local preferences relate to the landscape in Malinau and pointing at how to assess local preferences as a basis for better land use decisions.

The lessons learned provide baseline information that will support longer-term research. Because of the breadth of the effort and the many changes that took place during the life of the project, we are now in a much stronger position to identify both priorities and the steps required to find acceptable solutions to the many local challenges. The first phase of this investigation has provided clues to the technologies, policies and information that are needed to meet multiple objectives both within and across forest types in a given area. The focus of such a landscape approach is on the links among different activities and on the participation of the stakeholders in setting the research agenda.

Many views of forest use coexist within even small and apparently homogeneous groups. The people themselves are divided about whether they need the forest or are willing to cut it down, and their views change often. Overlapping institutions like local custom and government systems promote different views within groups, but for many stakeholders their access to the resources and benefits of the forest are the keys to their feelings for the forest.

The research has also allowed us to understand the community values and dependencies that have been largely overlooked by past governments and concession managers. These values are undergoing a period of particularly rapid change and re-examination, as new cash earning opportunities occur and the value of cash increases to the stakeholder. Competition for increasingly valuable resources develops and the different groups disagree about their claims and entitlements. Secure access to resources and benefits is the most important factor to many stakeholders. It is clear that these uncertainties in access discourage a concern for longer-term benefits and the environment. As the value of the resource increases, policy changes and uncertainty grows, then

the competition for benefits and conflict over ownership increases. Multiple demands exist and the poor are inevitably disenfranchised, encouraging them to take a short-term view of the exploitation of the resources available to them.

Stakeholders in a forest must coordinate management approaches if the forest is to survive. What has become obvious from CIFOR's collaborative work is that economic development in the area will require a very broad approach. As institutional mechanisms for coordination are in transition and not fully established for landscape-level or district-level management, mechanisms to facilitate communication and negotiation are required to accommodate the different values of the stakeholders. Higher-level district institutions will need to coordinate the efforts to develop the area, but their approach needs to be transparent so that all sectors will support the work.

The principles of the CIFOR-developed Model Forest would be useful in any future development work. The model operates on the basis of all stakeholders working to identify, develop and apply innovative forest management options. The management structures of the model ensure public participation in the planning processes. Workshops, presentations and informal consultations ensure that the district government understands the conflicting needs of the stakeholders involved in forest resource management. Such an approach will also lead to establishing mechanisms for conflict resolution and for specific procedures that ensure transparent decision making in the development of the district. In addition, the approach allows environmental, social and economic forces to operate in a consensus-based, decision-making process. The approach also requires researchers to identify research needs, test new methods in the field, then disseminate these new techniques to local stakeholders. The CIFOR research is already helping to reveal the needs of the area. In this way, forest resources be protected now and into the future as a productive element of the landscape.

Reducing the impact of logging on the forest

Overharvesting and poor operational practices are now recognised as an integral part of deforestation. In the Indonesian selective logging and planting system, all dipterocarps with a diameter at 1.3 m (height dbh) of over 50 or 60 cm can be harvested with a polycyclic felling schedule of 35 years. In the mixed dipterocarp forests of East Kalimantan, where the density of harvestable trees often exceeds 10 trees/ha, this minimum diameter rule results in excessive felling and produces high levels of damage to the remaining forest. Several experiments in mixed dipterocarp forests have demonstrated that reduced-impact logging (RIL) techniques can reduce damage by at least 30–50% compared with normal operations. Most of the studies comparing damage under RIL and conventional logging have neglected the variability in natural forest and the variation in damage that this implies. The main objective of this work was to assess how far RIL can reduce logging damage under varying felling intensities.

The research showed that RIL significantly reduced damage to the residual stand, and the cost savings from RIL skidding outweighed the additional costs of training and supervision. One of the most important benefits of the RIL experiment in Malinau was the significant reduction of wood waste left in the forest, representing a saving of about 11% for each cubic meter of commercial volume produced. However, it is widely perceived by concession holders that good planning costs more. Introducing RIL increases initial costs, but as the fellers and skidder operators involved in the RIL experiment found, they were able to meet the same daily volume in a shorter time than using conventional techniques. Overall, RIL has brought new perceptions of the benefits of good preplanning as a way of increasing logging efficiency.

RIL is a silvicultural approach, but the techniques can also combine with the forest dwellers' dependencies that the project's biodiversity research highlighted. In detailed exercises with local communities it was clear, for example, that wild pigs and timber trees are among the most valued species. Reducing damage to forests during harvesting is the most obvious step in lessening the impact of logging on vertebrates. In particular, it is important to minimise the area of severely damaged forest, such as along broad skidtrails and log-loading areas, where all trees and most of the topsoil are removed.

Other simple techniques could be incorporated into RIL, with powerful benefits for local people. For example, many poorer households are vulnerable to crop failures, floods, etc. and often depend on wild

foods for certain periods. A critical emergency food is sago (*Eugeissonia utilis*), which tends to grow just below the ridge tops, which is exactly where skidding machinery is used to extract logs on undulating local terrain. Protecting these palms is easily possible once the objective is recognised and the techniques developed and disseminated.

RIL techniques, as part of a more moderate extraction regime, are essential from the perspective of the growth and survival of the residual stand, but also for the longer-term ecological sustainability of the forest. New silvicultural prescriptions should be considered as a way to improve forest harvesting operations.

Biodiversity across the landscape

The main objective of the project's research into the biodiversity of the area was to use multidisciplinary methods across the landscape to provide quantifiable information on the local values placed on flora and fauna. This research has had three major components: finding out what occurs where, assessing to whom it matters and in what way and identifying what steps are needed to maintain this biota in the future. Together, these three strands of information help define priorities that reflect local considerations and inform a wide range of processes, from the development of reduced-impact logging guidelines to international forestry and conservation policy.

The research collected and quantified a vast amount of information on an area that was, until recently, little known biologically. The earliest studies involved wildlife and tree surveys prior to harvesting. Later surveys examined the wider landscape and determined local priorities. Our studies have provided baseline data on several major taxonomic groups. In many cases, and for plants and fish in particular, the records are part of a wider collection of information that includes geographical locations, ecological parameters and the needs and preferences of local communities.

We have developed a suite of methods to assess biodiversity and landscape information and what matters to local communities. Our methods emphasize the importance of deciphering the sometimes complex relations and interdependencies that can exist between local people and their environment. They are a step in clarifying local needs and concerns, in indicating key areas for further evaluation and in developing a mutually comprehensible dialogue amongst stakeholders, in particular illustrating how local preferences relate to the landscape in Malinau and pointing at how to assess local preferences as a basis for better land use decisions.

The natural forest is threatened because current forest degradation is happening so fast that it is difficult to implement conservation quickly enough. The forest understorey may be a key factor in conserving species that are valuable to local people, as well as preserving the habitat and controlling soil erosion and water turbidity. We already observe various responses by local communities in how they regulate their own impacts on the forest, such as the development of *de facto* protected areas. However, appropriate land uses require detailed study. The CIFOR research has allowed a GIS database to be started that could be used by all the stakeholders as one of the mechanisms for coordination and consensus on forest management. Once finished, it will also provide a means for monitoring changes in local values of biodiversity as well as the status of biodiversity in different localities.

The Malinau work has highlighted the need to understand in detail the effect that management techniques have on species and sites important to local people. In some cases, as with the ridge top sago, or the fish that are sensitive to turbidity and forest loss, the links are clear. In other cases, such as the species (for example, hornbills) that depend upon and compete for hollow trees, the implications remain less clear but justify consideration. All such factors must be taken into account in revising the RIL guidelines.

As well as the forest's importance to the local people, there are also many species of global conservation interest in the Malinau area. Through our review of what we know about the sensitivities of these species it will be possible to formulate improved guidelines for forestry practices. In some cases these will involve responsibilities and enforcement requirements for controlling actions that lie outside activities conventionally viewed as concession management, for example, controlling fishing using pesticides and limiting hunting.

Forest people's dependency on forest products

CIFOR sought to investigate the nature of the forest dweller's dependency on forest products in the Malinau landscape. We focused particularly on economic dependencies, although anthropological background studies were also made in communities where there was little previous information. Most of the people do not collect forest products on their own initiative. Economic dependency on forest products is seldom the result of free choice; it is often the sole option available to forest people to generate cash income. The traders decide which product they want to buy; they organize the collecting and control the marketing chain. It is this dependency that needed to be understood further.

Research among the Punan people in Malinau showed that as soon as new options are made available—labouring for concessionaires, wage working, migration to Malaysia, etc.—the dependency on forest products is reduced. People analyse the options at hand in a rational manner, from economic, social and cultural viewpoints. They weigh the advantages and disadvantages of regular and secure earnings, of higher but riskier earnings, of short-term versus long-term employment, of local versus distant job opportunities, and make informed decisions.

Nowadays, available opportunities are no longer restricted to forest product gathering. However, not all forest people are guaranteed equal rights to access these new opportunities. With the implementation of regional autonomy, some ethnic groups, and more precisely the leading classes of these groups, will probably be able to compete with outsiders. But the poorer classes and the marginalized communities will likely remain dependent on forest product gathering to make ends meet.

Up to now, there has been no real conflict over the use of the resource between shareholders or even among the communities. The local government receives taxes and local communities receive royalties, while 'investors' strike more profitable deals than ever. There is a clear consensus on the use of the forest; any conflict is only about the sharing of the benefits. Local populations need secure food and cash sources. The forest presently provides a large proportion of this. Affirming the community's legitimate ownership and rights to the resource has become the main concern of community leaders. Further steps to introducing practical conservation measures could involve local communities in forest management where they receive compensation for conserving forest as an attractive substitute for selling trees for logging.

There are variations in the degree of forest product dependency among ethnic groups and among individual households, as in the case of the Punan hunter-gatherers who depend more on forest products for their livelihood than the Dayak swidden cultivators. While forest products abound in the area and provide much of the livelihood needs of isolated communities, downstream areas have other options available in agricultural and off-farm activities. Nevertheless, there are common threads evident in development trends. There is inevitable tension between increasing access for economic development and the immediate threat that encourages the illegal use of the forest. A question that must be addressed is what kinds of precautions can be taken institutionally to prevent the unrestrained, short-term exploitation use of forest. Uncertainty in long-term access encourages all players, even those who will lose most, to take the short-term opportunities for cash, rather than risk the eventual complete loss of the resources. Solutions can be found by agreement amongst stakeholders. For example, local communities are often in favour of designating various forms of protected forest areas. The implementation of such solutions is however rendered difficult by conflict and short-term competition, as was revealed in the research on boundary negotiations.

Coordination and agreement in boundary negotiations

Boundary negotiations in Malinau highlighted the deeply political nature of coordination efforts among local communities, government and the private sector in the management of the forest landscape, and the uneven distribution of influence underlying them, even among seemingly homogenous community groups. Three years of study showed that the more intense the underlying struggle, the more fluid the interests, agreements and

coordination are likely to be. In Malinau, periodic opportunities to claim resources, as in the advent of decentralization, the changing monetary value of local resources, the new *Kabupaten* and mapping activities, immediately intensified competition for resources.

The research pursued mechanisms for constructive conflict management, focussing on the use of agreements to settle disputes. However, the work revealed that agreement-building processes were not necessarily fair or acceptable to all the people concerned. Building a supportive political constituency through consultation and transparent decision making appears to be the key to a lasting agreement. Mediators need to understand the diverse political relationships among groups to play a successful role in coordination and negotiation.

In Malinau, differences among villages in capacity and power affected nearly all aspects of negotiation, including how the conflict was defined. There is a need to build coordination upon sound social foundations about what are considered legitimate operating principles of negotiation and outcomes. Participatory mapping is an approach for building a strong bottom-up political base of support for demarcating boundaries so long as attention is given to the limits of making such processes truly participatory. Efforts need to be given to making processes more fair for disadvantaged groups, by giving them extra attention in training, working with their schedules, holding meetings in places convenient for them and enabling negotiations that acknowledge differences in power.

The research demonstrated the nature of coordination and agreement making in Malinau and its current vulnerabilities. The base of political support for coordination is fluid and often fragile. There are few safeguards to ensure fair negotiations for weaker groups. The authorities for supporting and endorsing these processes are unclear. Very real gains have been made, however, in empowering local communities to begin the process of asserting claims to their territories and of establishing debate about rights associated with those claims. A process has been started that communities, government and companies are now keen to complete.

Outcomes and future directions

The integrated approach to the research allowed us to identify a number of strategic problems that need to be addressed in Malinau, with implications for the management of forest elsewhere. In general, there is insufficient understanding of forest values and changing livelihood options that guide management objectives. There is increasing competition and demand for land and other forest resources. There is a lack of appropriate institutions for making management decisions. There is a lack of incentives and processes to encourage improved practices.

A secure forest estate requires consensus and stability on where and how the forest will be maintained and who will gain the benefits. An overriding concern is that the costs and benefits of forest management must be allocated with sensitivity to the needs and capacities of the many stakeholders. This requires in-depth analyses as to what the stakeholders 'do need and require', an evaluation of how various outcomes can be assessed, and how equitable agreements can be reached and maintained.

The situation in a forest is complex because of the range and diversity of the stakeholders and their overlapping claims of legitimacy. It also comes from the complexity of the biological system and the multitude of processes by which it relates to local livelihoods and wellbeing. Added to this are the complexity of the landscape and the way different impacts and benefits are felt or accessed at different locations in the landscape or beyond. Most of all, however, the complexity is in the way that all these aspects interact, multiple stakeholders and processes at a multitude of spatial and temporal scales.

The CIFOR study has highlighted much of this complexity while also clarifying the key aspects. By understanding how the forest can yield timber, while also maintaining other important values to numerous stakeholders, by recognising the threats and the institutional means available to address them, by understanding how the needs of the poorest communities of the forest see changes as both threats and opportunities, we can build up the understanding that decision makers need to make better decisions for sustainable forest management into the future.

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